SCIENTIFIC AMERICAN

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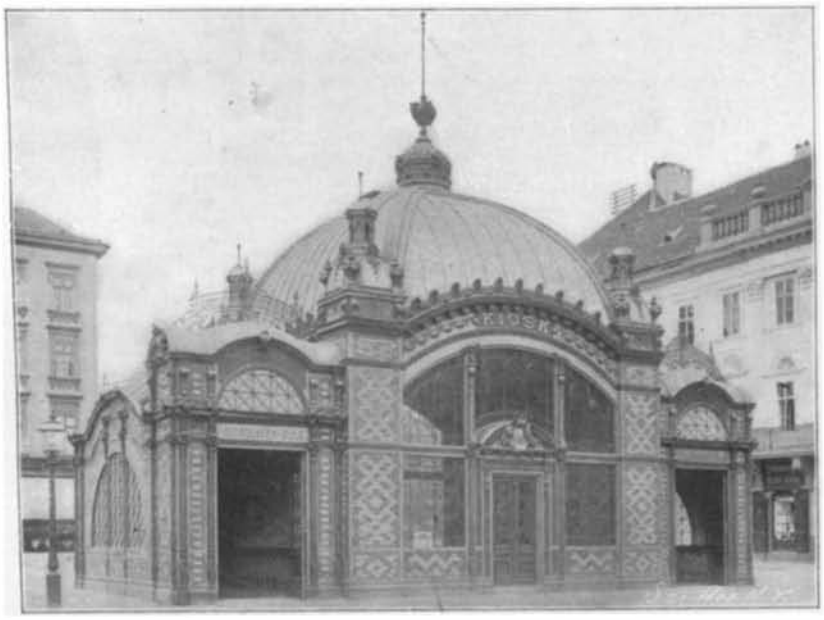
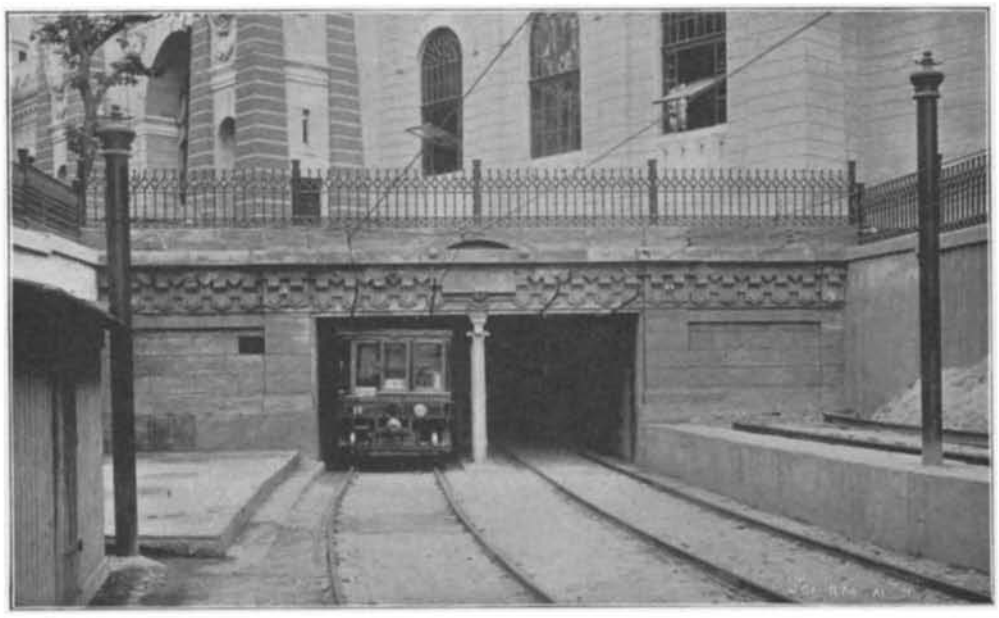
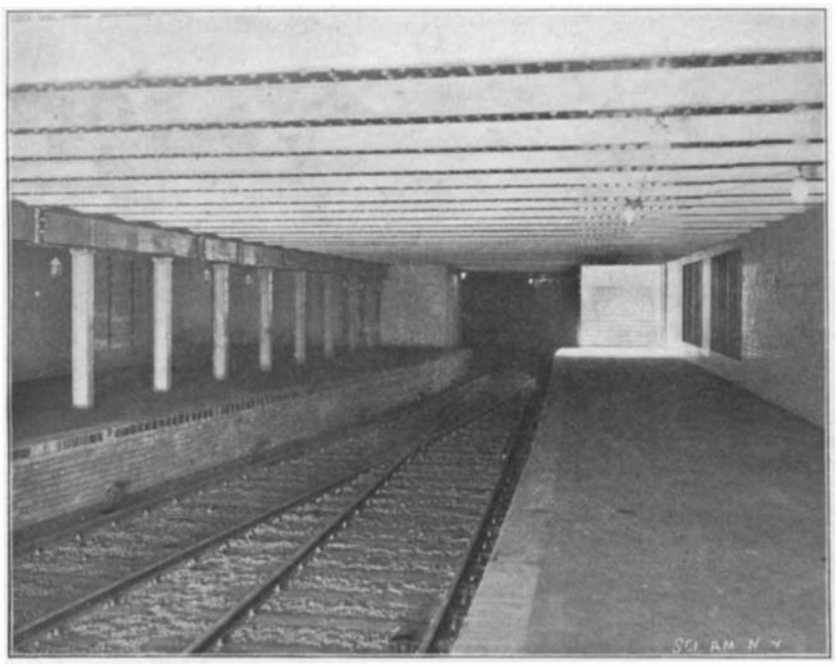


Entrance to Station, Buda-Pesth Underground.

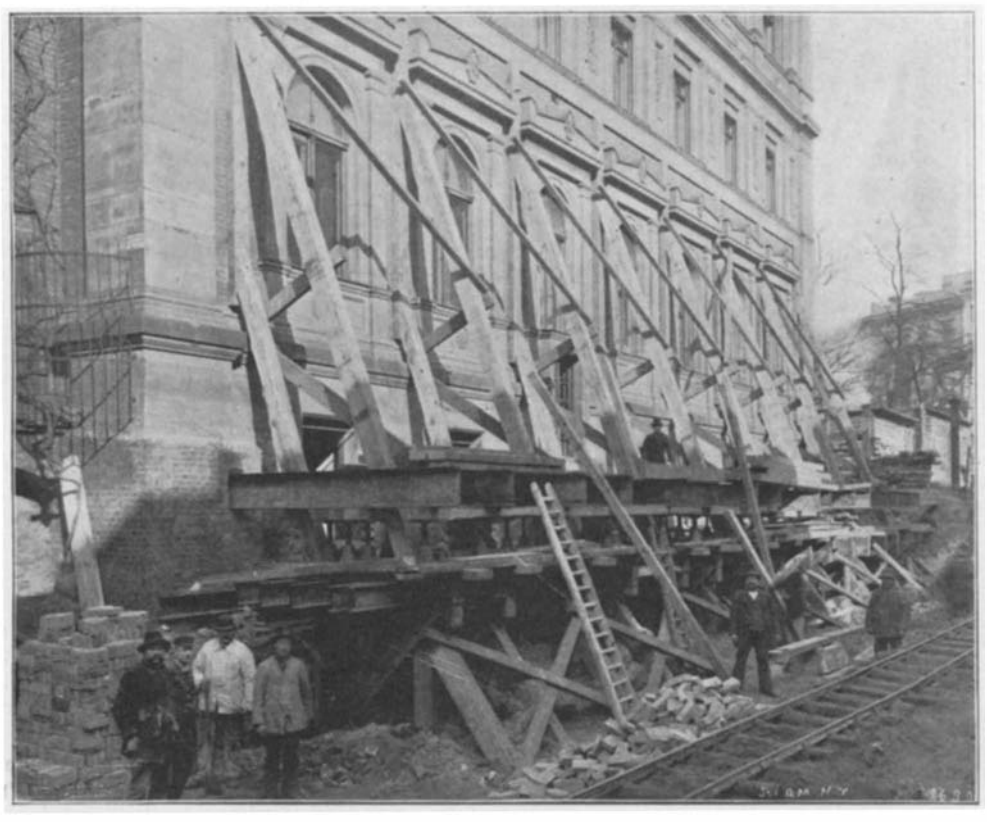


Entrance to Tunnel, Buda-Pesth Underground.

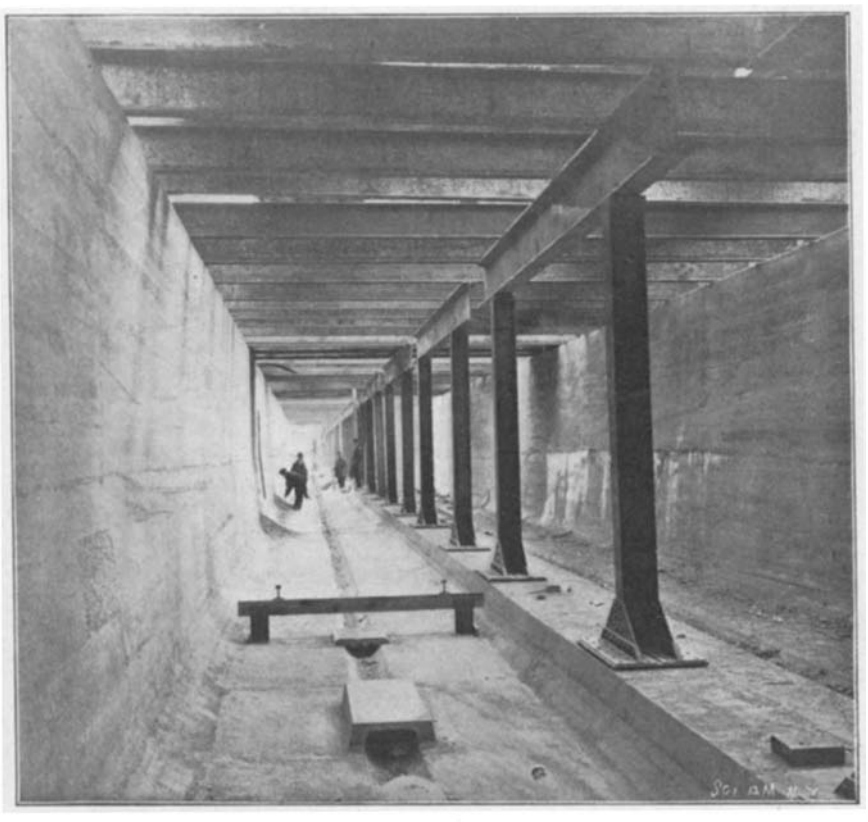


Subway Station, Berlin Underground Road.

Buda-Pesth Underground Electric Motor Car.

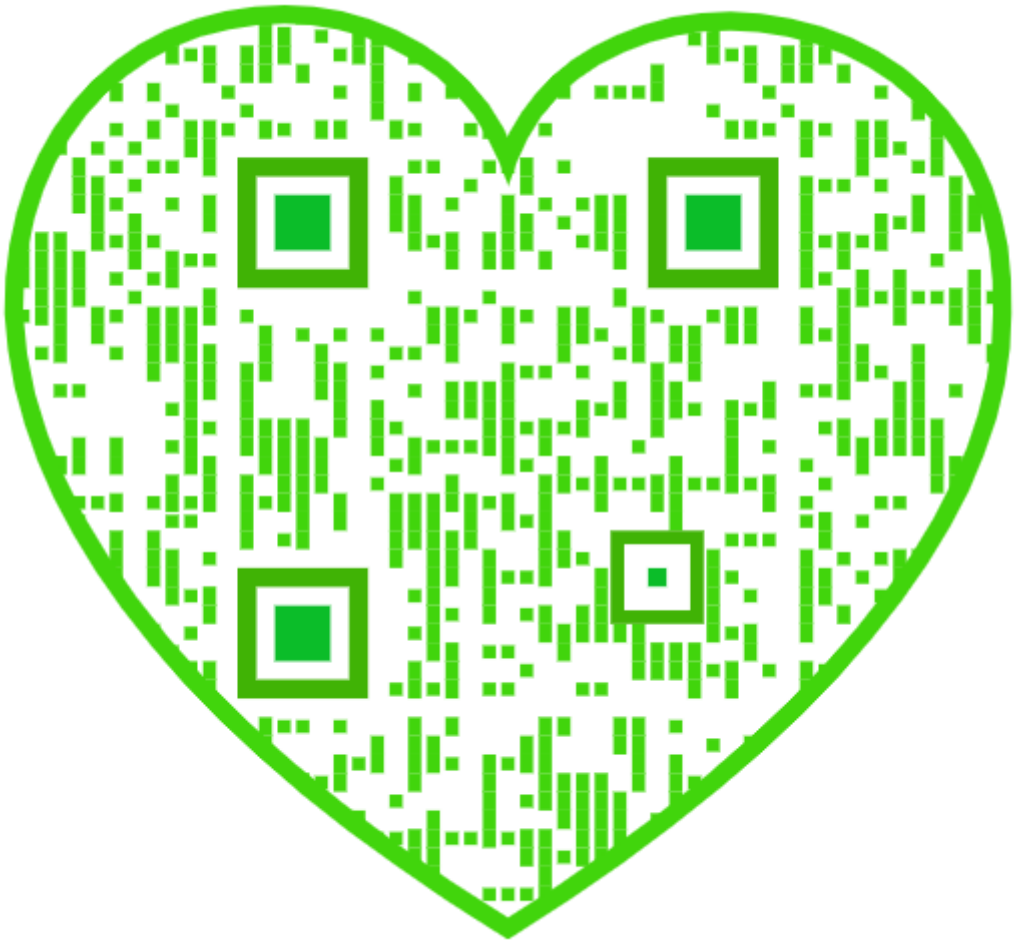


Underpinning of Large Building, Berlin Electric Railway.



Putting on Roof, Berlin Subway.

SOME CONTINENTAL UNDERGROUND ROADS.--[See page 311.]



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NEW YORK, SATURDAY, MAY 3, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE PANAMA CANAL TREATY.

A most important step has been taken toward the solution of the Isthmian Canal problem by the signing of a treaty by Secretary Hay and the Colombian Minister for a perpetual lease of the strip of land through which the Panama Canal is located. By this treaty the sudden deadlock in the negotiations, which was produced by the declaration of the Colombian government that it would have to be consulted before the selling of the Panama Canal Company's property was consummated, is removed, and the company is granted, unreservedly, the power to dispose of its entire right, title and interest to the United States, while all the questions relating to land franchises, revenues, rentals, etc., are satisfactorily settled. A strip of land six miles in width is to be perpetually leased to the United States, the lease to run by hundred-year periods and to be renewable at the option of the United States. By this treaty, the terminal cities Panama and Colon, the waters of the terminal harbors, and the islands adjacent, are brought under the control of the United States government. While no definite price is fixed by Colombia for these concessions, on the ratification of the treaty the United States is to pay to Colombia the sum of seven million dollars, in exchange for which Colombia foregoes all revenues from rental and from every other source connected with the canal for a period of fourteen years from the date of the final ratification. Meanwhile the terms of the rental are to be agreed upon. This may be either a lump sum paid in cash or an annual stipend to be paid for the remaining eighty-six years of the lease. Should the two governments disagree as to the terms of the rental, the question is to be decided by a tribunal of five members, two named by the United States, two by Colombia, and the fifth to be the presiding member of the Hague International Arbitration Court, or the president of one of the republics not allied to either party. This important document is not, as has generally been supposed, a mere protocol, but it is a full treaty, and as such will probably be sent to the Senate by the President immediately upon the passage of an act authorizing the construction of the canal.

GREAT STEAMSHIP COMBINE.

The many rumors that there was to be a combination on a colossal scale of the interests of some of the largest transatlantic steamship companies, have proved correct. Five of these companies, the White Star, Dominion, Leyland, Atlantic Transport, American and Red Star lines, with an aggregate tonnage that is estimated at nearly 850,000 tons, have been merged under the direction of J. Pierpont Morgan who, since the announcement of this important co-operation, has talked very freely concerning the aims and purposes of the movement. The capitalization of the consolidated companies is estimated to be in the neighborhood of two hundred million dollars, which fairly well represents the value of the property absorbed. According to the General Manager of the American Line, while the control of the company will be held in this country, it will be a strictly international organization, fostering the various companies included in the consolidation, preserving their autonomy, and giving every respect to their national and local surroundings. The avowed object of the combination is to afford better transatlantic service at a decreased cost. Hitherto the trade has been conducted extravagantly; and as a result of the conflicting interests, the sailings of the various steamers have not been arranged on the basis which would be most convenient and profitable, either to the companies or to the public. Other advantages expected are more uniform rates, a better distribution of traffic over the American and Canadian seaports, and additional lines on the Pacific and to South American ports, as the growth of traffic may be found to justify them. With lines already established between Great Britain and Australia and New Zealand, and with intimate connections with the Far East, the combine will be in the position to distribute American manufactured products throughout the world on through bills of lading, and to avoid the expense of transshipments which are incurred under the present arrangement.

It is claimed that the combination has no relation whatever to the question of the Subsidy Bill. Should the bill as considered by the Senate become law, of all the 850,000 tons owned by the combine, only a few vessels of the American Line could fly the American flag, and this for the reason that registry would be granted only to American-built vessels. Moreover, the company frankly admits that, failing the passage of the bill, they will build their ships in the cheapest market; which means that, as it costs twenty per cent more to build here than in Great Britain, the orders for new ships will go to British yards. On the other hand, should the Subsidy Bill be passed, there is no question that all the new ships for the combination, or a greater part of them at least, will be constructed in American yards and a powerful impulse will thus be given to the shipyards of this country.

STEERING WITH TWIN-SCREW ENGINES.

The advantages of the twin-screw system of propulsion of steamships have been proved once more in the case of a disabled Atlantic steamship. In this case it was the "Deutschland," the fastest of the transatlantic liners, that got into trouble, her rudder having been carried away at a point 400 miles west of Bishop's Rock. To a single-screw ship this disaster would have meant complete disablement; for although smaller vessels have been steered by jury rudders consisting of floating spars towed astern of the vessel, no such makeshift device could be rigged up that would control a 23,000-ton liner. As it was, however, by means of signals sent down from the bridge to the engine room it was possible to keep the great vessel on a true course, the port or starboard engine being given more or less steam to counteract the veering of the vessel as she sheered to port or starboard. It is conceivable that in ordinary weather a twin-screw ship would experience but little delay from an accident which, happening to a big liner of a dozen or fifteen years ago, would have rendered her completely helpless.

COMBINING THE AIRSHIP AND THE AEROPLANE.

Commenting in a recent issue upon the present prospects of successful aerial navigation, we pointed out that the great difficulty in constructing a practicable balloon airship was the great surface presented by the balloon to the wind, and the impossibility of producing a light motor of sufficient power to hold the airship against any but the most moderate winds. We also showed that the inherent difficulty of the aeroplane was its lack of what might be called static stability, and the difficulty of controlling the machine in making landings. The strong point in the one type is the weak point in the other. The airship can float and possesses stability, but its bulk and weight are fatal to speed and control. The aeroplane has no capacity for flotation and soaring except when in motion, and in its present stage of development it is a contrivance full of the greatest risk to life and limb. On the other hand, it is by far the lighter type of the two, and if the problem of control can only be solved, the questions of securing high speed and a wide radius of action, are merely a question of the production of a motor of great power for a given weight.

Just at present the most successful work in aerial navigation seems likely to be accomplished by a combination of the two types. Elsewhere in our columns we illustrate a machine built upon this principle, which is now being constructed for the British War Office. It is a true airship, of the type constructed by Count von Zeppelin and again by Santos-Dumont, the lifting capacity of the gas balloon being five tons. At the same time it is a true aeroplane, with a lifting capacity due to its planes of nearly a thousand pounds. The flotation of the device will be secured by the balloon, and the raising and lowering will be accomplished by the manipulation of the aeroplanes. We confess that apart from the fact that so conservative a body as the British War Office have entered upon the construction of a full-sized machine, there are features in the design of Dr. Barton which give reason to expect good results. Although it is only 180 feet long, as against a length of over 400 feet for the Count von Zeppelin balloon, its motors have a combined horse power of 135, which is much the largest installation yet placed on an airship. Zeppelin's great machine had only 32 horse power, while the new machine, No. 7, of Santos-Dumont with which he will experiment in this country, has a total of only 80 horse power. The combination of the balloon and the aeroplane should give an extreme nicety of lifting and lowering control, while the provision of water tanks at either end of the platform and an automatically-controlled circulation is a mechanical feature which will commend itself to every engineer. In view of the great [illegible] power, the expected speed of 20 miles an hour is decidedly conservative.

SANITARY CONDITION OF STREET CARS.

In view of the not inconsiderable portion of their time that the busy workers of a great city spend every day in the street cars, it must be admitted that the great importance which is attached by medical men to the sanitary condition of these cars is completely justified. For the average citizen there is not merely the long morning and evening ride to his place of business, but for many of us there is to be included much other time spent on the cars during the working hours of the day, and to this must frequently be added a ride of greater or less length to and from the theater or other place of entertainment at night.

Under normal conditions with a car only comfortably filled, the air, especially in the winter-time when ventilators and doors are kept tightly closed, is none of the best; and in the rush hours by day, and the theater hours at night, when the cars are jammed to the very doors and even to the steps of the platforms, the air is polluted to a point at which it becomes positively injurious to health. In the current issue of the SUPPLEMENT will be found an article by Dr. George A. Soper, of this city, dealing at considerable length with the sanitary condition of street cars in which the oft-repeated assertions as to the insanitary condition of street-car travel are substantiated by carefully-ascertained statistics. The physiological effects of poor ventilation are given as reduction of heart-action, increase in the rate of respiration, tendency toward headache, loss of appetite, reduction of vitality, nervous exhaustion and, in severe cases of delicate organization, the result of breathing vitiated air will be shown by nausea. Furthermore, the ability to resist disease is greatly lessened where the ventilation is poor. The tissues of the air passages of the nose and throat, which normally have the power of rejecting or destroying dangerous bacteria, become impaired, and the entrance and development of the organisms which are the cause of bronchial and pulmonary disease is favored.

The inefficient ventilation in street cars, particularly during the rush hours of the winter season, is too painfully evident, especially to those who are at all sensitive to vitiated atmosphere, to need much practical demonstration; but accurate analyses which have been made of samples of air taken from street cars, elevated cars and from trains running in the various tunnel systems both in this country and abroad, prove that the distress experienced by the "fresh air fiend" is only too well founded on physiological facts. Fresh air contains about three parts of carbonic acid, and air which has passed through the lungs, 441 parts of carbonic acid per 10,000 volumes, and the air of inclosed spaces becomes "close" when carbonic acid exists to the extent of about five parts per 10,000 volumes; hence, Dr. Soper deduces that about 50 cubic feet of fresh air should be admitted to each car every minute for each person it contains. It is perfectly certain that no such ventilation takes place, at least in the winter-time, and analyses of samples of air taken from cars in New York showed that they contained as much as 26.2 parts of carbonic acid gas as against the three parts found in fresh air. On account of the less frequent opening of the doors, it has been found that on the elevated roads the percentage is higher, samples having been found to contain as high as 31.2 parts of carbonic acid. A table showing the amount of this poison in the air in various tunnels and street cars proves that the worst offender is the Mont Cenis tunnel; with 107 parts per 10,000 volumes. The Mersey tunnel, Liverpool, showed from 7.4 to 26.4 parts, and the South London Electric Railway tunnel from 8.4 to 10.8 parts. These results on electric roads are to be compared with those shown in the steam-operated Metropolitan Railway tunnel, London, where there was a maximum of 89.4 parts. In the Boston subway, the samples contained from 6.63 to 9.45 parts, while an electric car in the Boston subway showed a maximum of 24.97 parts.

This subject should have particular interest just now in view of the subway systems which are being constructed in this and other cities. We believe our tunnel Commissioners are relying upon the piston-like action of the trains themselves in passing through the tunnel to serve the purpose of ventilation, the theory being that the movement of the train carries a body of air in front of it and sucks in at the stations and various openings fresh air from above. We fear that the expectations based upon this theory are liable to disappointment in the case of the new subway, for the reason that the conditions are not parallel to those obtaining in the tube tunnels, say of London, where there is only one track laid in each tunnel and the train is built so as to conform to the section of the tunnel, and nearly fills in the entire space. No doubt the passage of a train through a tube of this kind does act with an expelling force upon the air in front

and acts by suction to draw in fresh air at the stations; but on a four-track road the passage of one train can do nothing more than produce a certain amount of eddying in the atmosphere and certainly can have no general effect of renewing the whole body of air in the tunnel. At the same time it must be remembered that the problem of air renewal is simplified by the fact that the subway lies very close to the surface, and not, as do the London tubes, 60 or 80 feet below it. The use of electric traction will, of course, preclude any such state of things as revealed by the 89.4 per cent of carbonic acid gas that was found in the steam-operated tunnel of the Metropolitan Railway, London.

LORD KELVIN—ENGLAND'S GREATEST LIVING SCIENTIST.

Although a Scotchman by descent, Lord Kelvin was born in Belfast, in 1824. His father, Dr. James Thomson, was a well-known mathematician in his day, who filled the chair of mathematics both at the Royal Belfast Academical Institution and at the University of Glasgow. From his father the present Lord Kelvin clearly imbibed that taste for mathematics which marks all his scientific investigations. Together with his brother, Thomson studied at Glasgow College. From Glasgow he went to St. Peter's College, Cambridge, graduating in 1845. That his main work at Cambridge was mathematical goes without saying.

Even before his Glasgow student days came to an end, William Thomson's original work in science had begun. His first mathematical papers, written before he entered Cambridge, discussed the Fourier mathematics, then but little known. In 1842, when but seventeen years of age, he published a paper on "The Uniform Motion of Heat in Homogeneous Solid Bodies and Its Connection with the Mathematical Theory of Electricity." Even in that early paper he points out the analogy between certain problems in the conduction of heat and in the mathematical theory of electricity and magnetism; and he shows how to make use of solutions of the one set of problems in order to arrive at important conclusions with regard to the other. The papers which we have mentioned were followed by a treatise on "The Linear Motion of Heat," which contained principles later so powerfully applied to the question of "geological time."

Owing to the very limited amount of space at our disposal it is impossible even to mention the many papers with which Thomson enriched the literature of pure physics. In the early forties electricity was passing through a transition stage. The discoveries of Faraday had opened up an unsuspected field. The function of the dielectric had been discovered and traced out; and the doctrine of lines of force had been expounded. Thenceforth action at a distance, so far as electricity and magnetism were concerned, was a notion of the past—an hypothesis utterly untenable and incapable of representing the facts of the case. Thomson eagerly grasped this truth; and using the new discoveries as the basis of his mathematical investigations, gave to them a mathematical form, which rendered them of practical service to later electricians.

Thomson's early investigations were soon translated into the language of "the potential;" and the connection was established between these results and the theories of energy, with which Joule was just then concerning himself. Thus it was that Thomson, at the early age of twenty-one, become the exponent of doctrines, the full value of which can scarcely be said to have been appreciated until he had reached his fortieth year. In 1867, the word "potential," which is now one of the stock terms familiar to every electrical student, was unknown, except to a few advanced mathematicians.

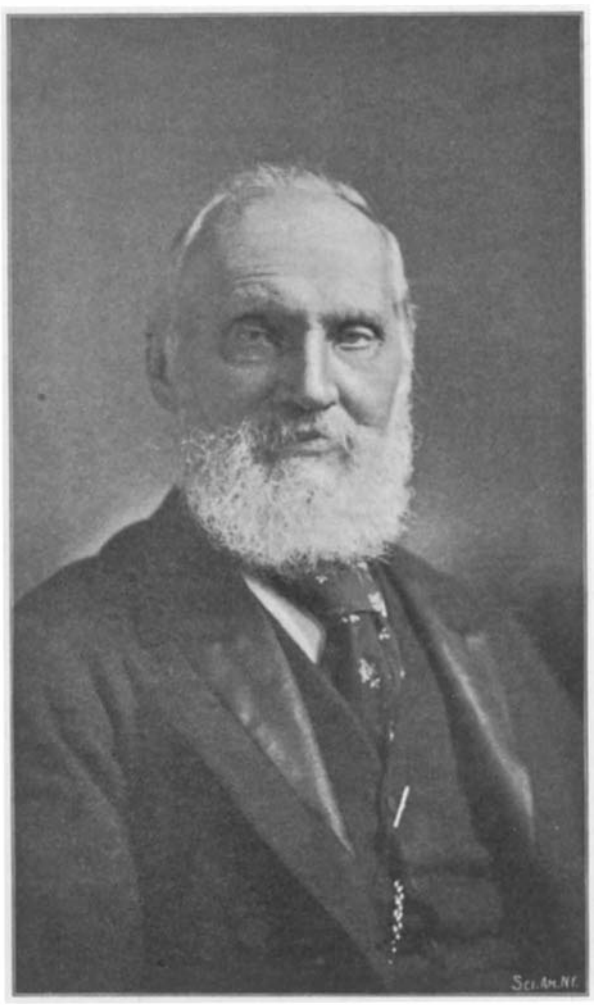
At twenty-two Thomson was elected Professor of Natural Philosophy in the University of Glasgow—a chair which he has filled with honor and distinction up to the present time.

As we have already seen, even in his student days, Thomson had been attracted to the dynamical theory of heat. He was one of the first to appreciate the importance of the work of Joule. One of his earliest papers on thermo-dynamics shows how the theory of Carnot may be adapted to the modern doctrine of heat. Thomson's papers on the subject of thermo-dynamics constitute one of the most valuable and most remarkable contributions made to modern physical science. In 1852 the principle of the dissipation of energy was announced, in connection with which experimental determinations were undertaken both by Joule and Thomson. More than one joint paper of rare value was contributed by these two life-long friends.

In 1855 and 1856, the problem of ocean telegraphy was placed before scientific men for solution. Thomson ardently threw himself into the work and gave to the world the first practical solution. Only a brief account of this, his most important practical work, can here be given.

Following the experiments of Faraday, Thomson had investigated mathematically the retardation of signals, and had formulated the law of squares, now so familiar in telegraphy. When the possibility of laying down a cable across the Atlantic was discussed, he pointed out that a conductor 2,000 miles long, unless of unprecedentedly large cross section, might prove a commercial failure, on account of the slowness of the transmission of signals. The warnings of Thomson were not heeded. It was only when the 1858 cable was completed that the full force of his contention was appreciated. When Whitehouse, Thomson's rival, failed to make good his promises of transmitting messages at a fair rate of speed, Thomson was sent for by the directors of the company, and asked to provide an instrument that would satisfy the conditions necessary for its success.

Experimenting with the reflection of the image of a candle thrown from his concave eye-glass on a sheet of white paper in a fairly lighted room, Thomson judged that the flame of a paraffine lamp reflected from a silvered mirror would give an image bright enough for the convenient reading of telegraphic signals. Such was the germ of the mirror-galvanometer. Mirrors and instruments were soon made; and in 1858 the mirror-galvanometer was successfully applied to the cable. The instrument is the first of Thomson's many inventions. With characteristic generosity he had intended to abandon the instrument to the public, but was finally induced by the company to take out patents. The fruit of his labors in developing the



LORD KELVIN, LL.D., F.R.S., ETC.

sounding machine and the mariner's compass he was also willing to leave unprotected. Sounding by piano wire was offered to the Admiralty, as well as the compass; but he found in each case that the only way of securing public attention to inventions was to patent them and work the patents.

In 1867 the siphon-recorder was invented and patented by Thomson. Three years later it was used on ocean telegraph cables. Up to the present time the mirror-galvanometer and the siphon-recorder are the only instruments by which signals are read on very long submarine lines.

For five or six years he devoted himself to electrical problems of transcendent difficulty. Almost every department of electricity bears the impress of his work. That a scientist of his attainments should have received honors from every country in the world is but a small acknowledgment of the valuable work he has done in modern science. He succeeded Sir George Gabriel Stokes as president of the Royal Society in 1890, and was created first Lord Kelvin in 1892. He is a Fellow of almost every scientific society of note throughout the world, bears degrees conferred upon him by half the universities of Europe, and has received numerous medals for his eminent inventions and discoveries. The present is not Lord Kelvin's first visit to this country. In 1876 he was a judge at the Centennial Exhibition. In 1884 he visited America to attend the Montreal meeting of the British Association. In 1897, the date of his last visit, he attended another meeting of the British Association held at Toronto.

THE HEAVENS IN MAY.

BY HENRY NORRIS RUSSELL, PH.D.

In concluding our description of the zodiacal light last month, we referred to the fact that, under favorable conditions, it can be seen to extend entirely across the sky as a very faint band of light which, in the region that lies opposite the sun, brightens into a faint spot of light.

This spot is commonly known by the German name Gegenschein—a *glow* in the sky.

The Gegenschein is one of the faintest objects known; yet it is easier of observation than has often been supposed.

The observer should glance rapidly across the sky from the zenith to the horizon. A few such sweeping glances will probably convince him that there is a region some distance above the horizon where the background of the sky is sensibly brighter than in the regions above or below it. This region lies at present in the constellations of Virgo and Libra. He should now repeat the process, sweeping the sky from right to left, along the brighter region previously noticed, when he will probably see that a certain region is brighter than those to the right or left of it. It can best be studied by glancing across it from one side to the other, rather than by looking directly at it.

The position of its center among the neighboring stars may now be estimated, and if this position, when looked for on a star map, lies near the ecliptic, and about 180 deg. from the sun's place on it for the day of observation, the observer may be sure that he has seen the Gegenschein.

THE HEAVENS.

At 9 P. M. on May 15 Cygnus is rising in the northeast. Above it, on the right, is Lyra, and Hercules is farther on in the same direction. The brilliant Arcturus high up on the southeast of the zenith, marks the position of Bootes, and the little circlet of corona lies between it and Hercules. The intertwined constellations of Ophiuchus and Serpens fill the large area below them, while the red Antares, low in the southeast, shows that Scorpio is rising there.

Virgo lies south of the zenith, its brightest star, Spica, being nearly on the meridian. Libra lies between Virgo and Scorpio. Leo is southwest of the zenith, and Hydra stretches its ungainly length below it. Canis Minor, Gemini and Auriga are near the western and northwestern horizon.

Ursa Major is above the pole on the left, and Draco on the right, while Cassiopeia and Cepheus are below the pole, near the northern horizon.

THE PLANETS.

Mercury is evening star throughout the month. At first he is too near the sun to be seen, but later on he is remarkably well placed for observation. His distance from the sun is greatest on the 28th, when he sets two hours and twenty minutes later than the sun. He can therefore be well seen in the northwest, much less involved in the twilight than usual.

Venus is conspicuous as a morning star, rising about two hours and a half before the sun.

Mars is also a morning star, but is still too near the sun to be observed.

Jupiter is morning star in Capricornus. On the 6th he is in quadrature with the sun, and is due south at 6 A. M.

Saturn is morning star in Sagittarius and is due south at 4 A. M. in the middle of the month.

Uranus is in Ophiuchus, coming to the meridan at 1:40 A. M. on the 15th. Neptune is in Gemini, too near the sun to be seen.

THE MOON.

New moon occurs on the afternoon of the 7th, first quarter on the morning of the 14th, full moon on that of the 22d, and last quarter on that of the 30th.

The moon is nearest us on the 8th, and farthest away on the 23d.

She is in conjunction with Venus on the 4th, Mars on the 7th, Mercury on the 8th, Neptune on the 10th, Uranus on the 23d, Saturn on the 27th, and Jupiter on the 28th. On the 19th there occurs an occultation of the bright star Spica, in Virgo. As seen from Washington, the star disappears behind the moon's dark limb at 1:48 A. M., and reappears at the other side of the moon 47 minutes later. This interval will be longer for places north of Washington, and shorter for those south of it.

On May 7 there occurs a partial eclipse of the sun. As it is visible only in New Zealand and the Pacific Ocean south and east of it, it is of little importance to us.

Princeton, N. J., April 19, 1902.

Captain Morse, Chief Signal Officer of the Department of California, has received orders from the War Department to open negotiations for the installation of a system of wireless telegraphy between army stations in Alaska.

NEW AIRSHIP UNDER CONSTRUCTION FOR THE BRITISH WAR OFFICE.

BY OUR ENGLISH CORRESPONDENT.

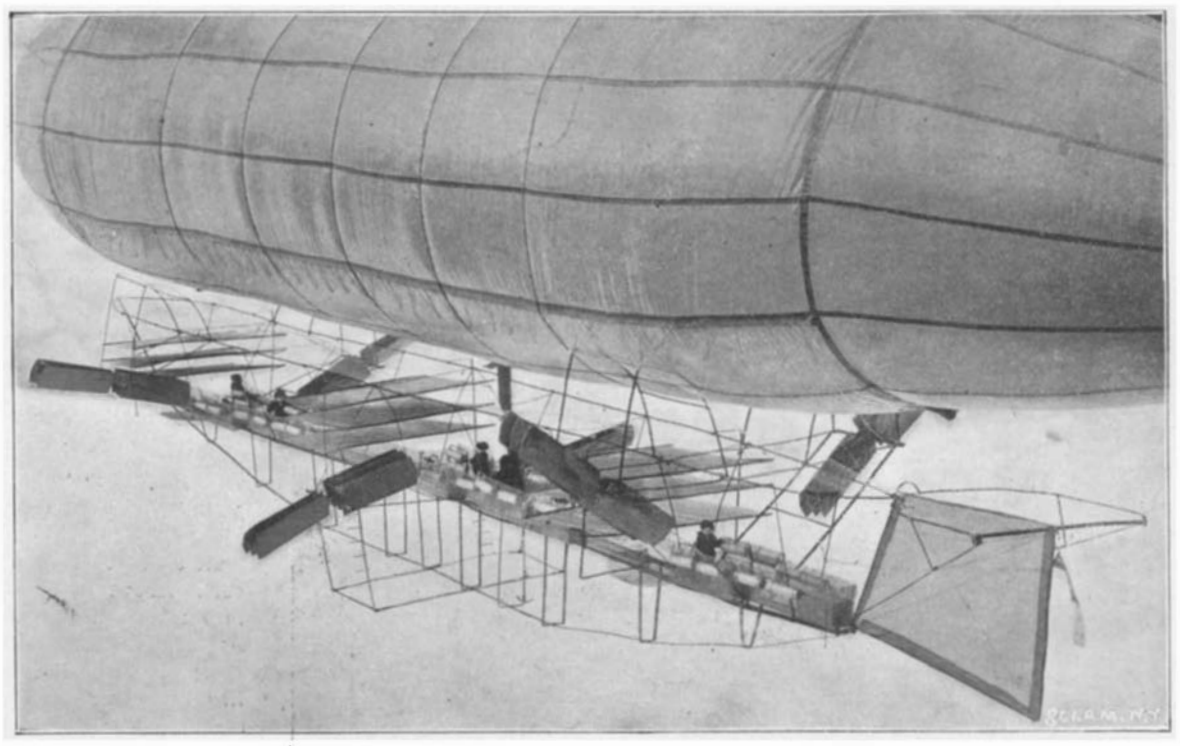
The designer of the airship which is herewith illustrated, Dr. Barton, of London, England, after devoting the past two decades to the practical study of aerial navigation, has closed a contract with the British War Department for the construction of an experimental airship, on the lines of the model herewith illustrated, which is built on a scale of one-twelfth. Special interest attaches to it from the fact that it combines the good qualities of both the airship and the aeroplane.

The cigar-shaped balloon measures 180 feet over all, with a maximum diameter of 41 feet. The greatest diameter occurs at a point 72 feet from the bows. It is divided into three compartments. The diaphragms, or dividing walls, are built loosely, and are fitted with a special contrivance to permit the passage of the gas from one compartment to another, at will, the necessary action for this purpose being controlled from the car, as follows: In the central compartment is a balloonette of 12,000 cubic feet capacity, into which air, at a pressure of approximately one atmosphere, is pumped, to compensate for any leakage that may possibly occur in the balloon, and which is let out when the hydrogen expands, so that none of the gas is lost, while the whole structure is kept rigid. The balloon has a capacity of 144,000 cubic feet of hydrogen which, together with the 12,000 cubic feet air capacity of the balloonette, represents an aggregate capacity of 156,000 cubic feet, while its lifting capacity will be roughly 10,000 pounds.

The balloon is built of varnished Japanese silk, and over this is fitted a "chemise" covering, in the edge of which are sewn fine strips of bamboo, bound together so as to form one long suspending rod, to which are attached the cords that run down to the aeroplane frame. This bamboo is continued up over the nose to almost the largest diameter of the balloon, and through the side pieces as well as over the ends. These pieces are all connected by bamboo bound together in a similar manner and fastened in gussets in the chemise.

The aeroplane frame is 120 feet from end to end. It is built of tubular steel throughout. To this frame are fitted the three sets of horizontal aeroplanes, three to each set, which constitute the salient feature of the Barton airship. One set of aeroplanes is fitted near either end of the frame, and one in the center. The slats are placed one above the other on the interior transverse bars of the frames, but are movable up and down in an arc, the center of which is posterior to the anterior transverse bars. When resting in a horizontal position they are aeroplanes, but when raised or lowered form aerocurves. Each aeroplane measures 12 feet in length by 18 feet in width, thus giving a superficial area of 216 square feet per plane, and a total area of 648 square feet for each set of planes, while the aggregate superficial area of the three triple sets is 1,944 square feet. The aeroplanes are constructed of varnished Japanese silk, stretched out upon frames, and sufficiently supported by transverse bracings.

The inventor, in the combination of the aeroplanes with the balloon, has availed himself of the results of Mr. Hargreave's experiments with kites. The latter discovered that an aeroplane forced against the air at a speed of 20 miles per hour will give a lifting power of 2 pounds to the square foot. Dr. Barton in his airship has reduced Hargreave's lifting power per foot at the same speed to one fourth, so that even allowing ½ pound lifting power per square foot, with 1,944 square feet, which is the total superficial area of three triple sets of aeroplanes in his machine, a lifting power of 972 pounds results, which is equivalent to letting out approximately 14,900 cubic feet of gas or throwing out 972 pounds of ballast.



Length, 180 feet; diameter, 41 feet; horse power, 135; speed, 20 miles an hour.

AN AEROPLANE AIRSHIP UNDER CONSTRUCTION FOR THE BRITISH WAR OFFICE.

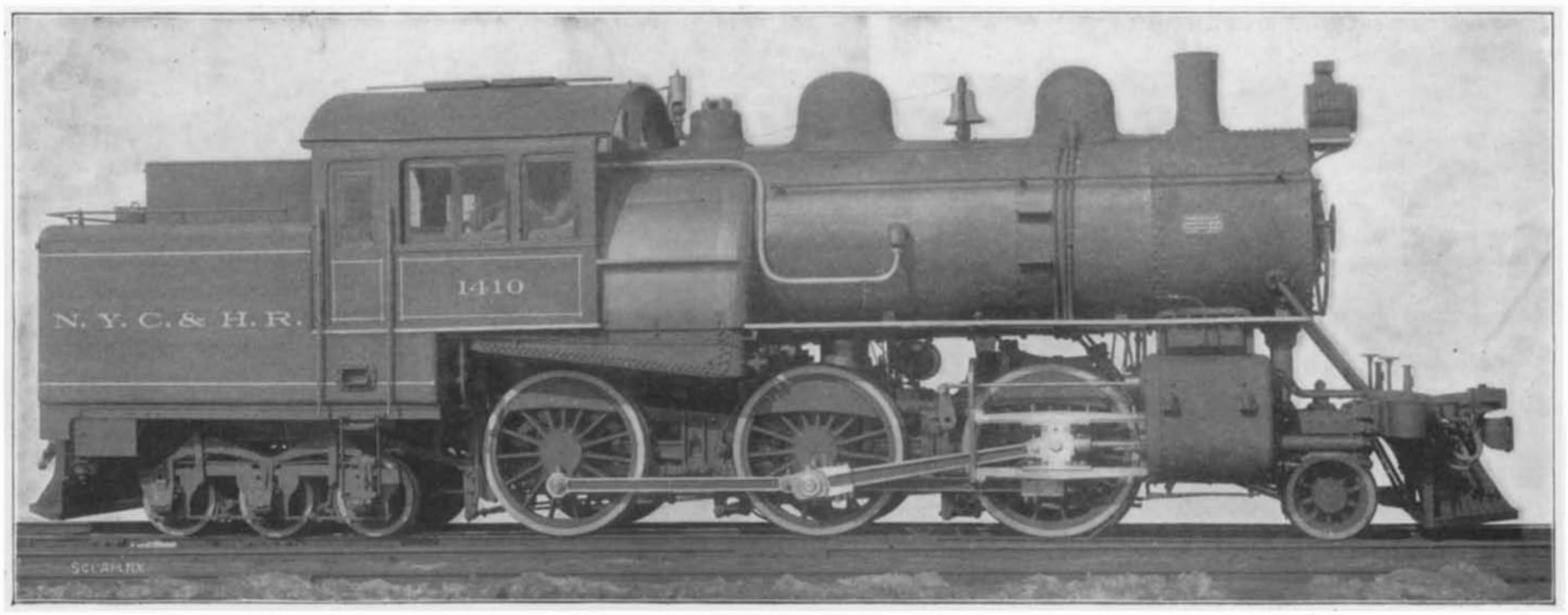
The airship is forced through the air by six sets of propellers, three on each side, placed at the bows, amidships and at the stern respectively. The set amidships, however, is placed in a lower plane than the bow and stern sets. They are of the two-blade triple Mangin type, each propeller measuring 17 feet from tip to tip by 2½ feet maximum width. Each pair of propeller sets is driven by a 45 horse power four-cylinder petrol engine and the thrust obtained will be 900 pounds, estimating a force of 20 pounds per horse power. As there are three sets of engines, one for each pair of propellers, the aggregate horse power is 135, which produces a total thrust of 2,700 pounds. Dr. Barton, however, anticipates obtaining a force of 25 pounds per horse power so that the aggregate thrust will be increased to 3,375 pounds.

The inventor has relinquished the sliding weight or trail rope counterbalance, but has devised an ingenious system of automatic water balance. At each end of the car is a tank capable of stowing 50 gallons of water. These tanks are connected by two pipes, running underneath the car. Amidships each pipe passes through a double pump, pumping in opposite directions, driven by a single cylinder 3½ horse power motor. Close to the aeronaut in charge of the steering apparatus is a pendulum, which is connected to cocks fitted to the above pipes, and controls the direction of the flow of water to and from the tanks. These cocks are opened or closed automatically according to the swing of the pendulum. When the ship is perfectly horizontal, the pendulum hangs at right angles to the deck, and both cocks are open, the water circulating freely and evenly between the two tanks. Immediately the ship dips at either end, the pendulum indicates the degree of deviation from the horizontal, and the water is shut off from flowing from the raised into the depressed tank, while the water pumped from the lat more freely into the form thereby equalizing the weight and causing the ship to resume its equilibrium. Supposing, for instance, the engineer at the forward motor walks to the stern. As he traverses the deck the center of gravity is shifted, and the ship will commence to dip down at the stern. The pendulum comes into action, the water supply from the forward tank is cut off, and the water is pumped from the stern tank more quickly into the forward tank, the operation being continued until a volume of water equivalent to the weight of the engineer has been discharged from the stern into the bow tank, thus compensating the removal of the engineer s weight upon the bows. The car is built on the latticed bridge principle and is 104 feet in length. Three hundred and sixteen gallons of petrol are carried for the supply of the propelling motors. It is stored in cylindrical tanks, each of six gallons capacity, slung upon either side of the car.

The War Office airship is to travel at a speed of 20 miles per hour, and to have accommodation for seven men. It is to be equipped with every appliance necessary for reconnoitering and signaling. For maintaining communication with the earth a wireless telegraphic apparatus is to be installed. It is to remain steaming in the air for 48 hours. A French government firm has already endeavored to purchase the Barton airship, but a contract has been entered into between the British War Office and the inventor for its exclusive use by the British Military Department, and the essential and vital details of the vessel are maintained secret, the negotiations for patenting the invention having been interrupted by the authorities. The government trials are to be carried out in the course of the next two or three months.

POWERFUL LOCOMOTIVE FOR SUBURBAN SERVICE.

For suburban work, where there is frequent stopping and starting, the steam locomotive is at a great disadvantage as compared with the electric motor, because of the much more rapid acceleration which is



Cylinders, 20 by 24 inches; driving wheels, 63 inches diameter; heating surface, 2,437 square feet; steam pressure, 200 pounds to square inch; weight, 108 tons.

POWERFUL LOCOMOTIVE FOR SUBURBAN SERVICE.

possible with the latter. The average speed of the suburban train is very largely a question of rapidity of starting and stopping. In regard to quick stops, of course, the steam and electric service are on the same basis, although the introduction of the magnetic brake, which is being applied so successfully in the street car service, would place an electrically-operated system at a great advantage, even in respect of rapidity of stopping. It is in the relatively slow acceleration that a steam suburban service is handicapped as compared with one operated electrically.

With a view to handling its suburban trains with greater despatch, the New York Central Railroad Company has brought out a suburban locomotive of great size and power, of which we herewith present an illustration. The first of this class was built by the American Locomotive Company several months ago, and the service which it gave was so satisfactory that a later order was given for fifteen additional locomotives of the same type. As will be seen from the illustration, the locomotive is carried on no less than fourteen wheels, consisting of a pony truck, six coupled drivers and a six-wheeled truck beneath the tender, the latter being carried on the same frame with the boiler and engines. The barrel of the boiler, which is of the straight, wide firebox type, is 70 inches in diameter. The firebox is 93 inches in length, 97⅞ inches in width, and 67 inches in depth at the front end and 53½ inches at the back. There are 365 2-inch tubes which have a total length over tube sheets of 12 feet. There are 2,275 square feet of heating surface in the tubes, and 162 square feet in the firebox, making a total heating surface of 2,437 square feet, while there are 62 square feet of grate surface. The steam pressure is 200 pounds to the square inch.

The cylinders are 20 inches in diameter by 24 inches stroke, and the driving wheels are 63 inches in diameter. The slide valves are of the piston type, with inside admission and 5½ inches travel when in full gear. The engine frames are narrowed down to plate form where they extend under and support the tank.

The weight of this fine engine in working order is 216,000 pounds, of which 128,000 pounds is on the driving wheels. The tender has a capacity of 3,700 gallons of water and 5 tons of coal. These are considerably the heaviest and most powerful engines ever made for suburban service for this or any other country.

The fifty-first meeting of the American Association for the Advancement of Science will this year be held at Pittsburg, Pa., from June 8 to July 3. Mr. Stewart Culin, of the University of Pennsylvania, will preside over the section of Anthropology

THE GROWTH OF THE TRANSATLANTIC STEAMSHIP.

On July 4, in the year 1840, a little wooden sidewheel steamer cast loose from her dock at Liverpool and fourteen days and eight hours later steamed into Boston Harbor, amid the acclamations of the assembled citizens and every manifestation of civic pride and rejoicing. The little craft was the "Britannia," the first of the since-famous Cunard line, and the first steamer to sail under regular government contract for the conveyance of the transatlantic mails. In the accompanying very interesting diagram, showing the growth in size of the transatlantic mail steamship, we have commenced with the "Britannia" for the reason that although she was not, by any means, the first steamship to cross the Atlantic, she was the first to do so on a regular schedule. The Cunard Company continued for many decades to be the most prominent of the transatlantic steamship companies, and the successive vessels put afloat by this company are representative of the development of the steamship. The first seven of the vessels shown in our diagrams, therefore, are chosen from the records of the Cunard Company.

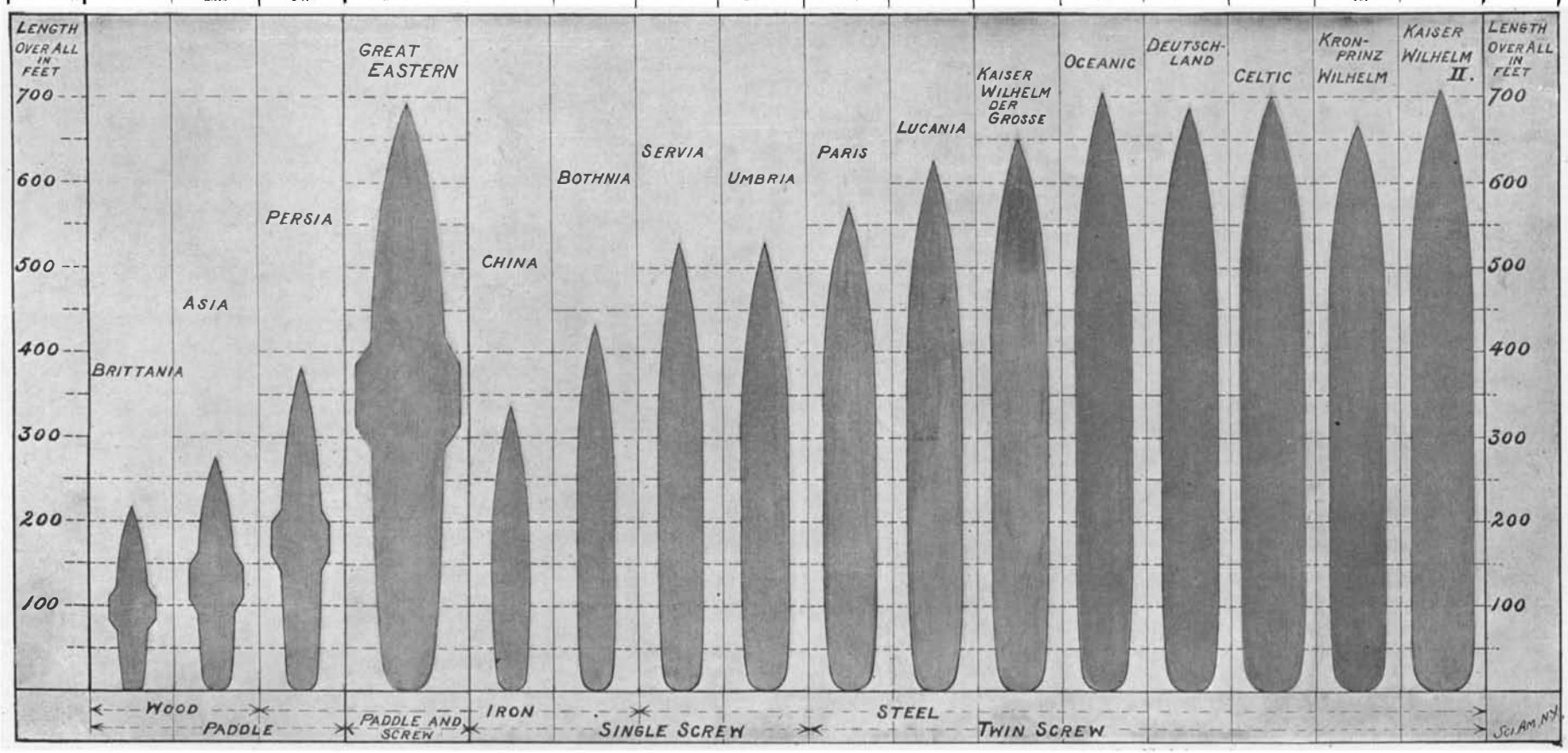
The "Umbria" was the last, largest and fastest of the single-screw vessels, and it was not until the "New York" and the "Paris" of the Inman and International Company were built, that the twin-screw steamer made its appearance on the transatlantic route. After this time the credit of producing the notable steamships of the world is jointly due to the Cunard Company, the White Star, and the two great German companies, the Hamburg-American and North German Lloyd.

The "Britannia," as we have said, was a wooden sidewheel steamer. Her length over all was 215 feet; her beam 34 feet 4 inches; her molded depth 24 feet 4 inches, and her displacement 1731 tons. Her engines of 740-horse power gave her an average sea speed of 8.5 knots an hour. She was one of four sister ships which were built under a seven years' contract with the government, by which the company was to provide four steamers and despatch one of them from Liverpool for Halifax and Boston on the 4th and 19th of every month from March to October, and on the 4th of each of the four winter months. For this they were to receive a subsidy of $400,000 per year. During the ten years from 1840 to 1850 the company added six additional wooden paddle-steamers to their fleet on the Atlantic and had a practical monopoly of the trade; but the formation of the United States Collins line introduced an element of fierce competition, to meet which two larger and faster boats, the "Asia" and the "Africa," were built. They were 275 feet long over all, 40 feet beam, 27 feet 2 inches molded depth and displaced 3,340 tons With 2,400 horse power they maintained an average speed of 12.5 knots an hour across the Atlantic. Seven years previous to this the great Brunel had built the first iron steamship, "Britannia," and the success of this vessel induced the company to build their next mail ship, "Persia," of the same material. Launched in 1855, the "Persia" was a great advance in size and power on all previous vessels. She was 385 feet on deck, 45 feet 3 inches in beam, 31 feet 6 inches in molded depth, and her displacement was just under 5,000 tons. With 4,000 horse power she maintained an average speed for the whole passage of 13.8 knots an hour. The "Persia" and her sister ship, the "Scotia," were the last of the big sidewheelers.

We have introduced into our diagram a phenomenal vessel which, strictly speaking, should not have any place in the history of the development of the transatlantic mail steamer, for the reason that she was never run on any regular schedule under a government contract. We refer to the "Great Eastern," and she is shown in our diagram to emphasize the fact that she was fifty years ahead of her time and, in fact, anticipated in point of size such vessels as the modern "Oceanic" and "Celtic." The "Great Eastern" was a splendidly-built ship, and cost no less than $3,650,000. She was 692 feet long on deck; 118 feet broad over the paddle-boxes; her beam was 83 feet; her depth 58 feet, and her displacement about 28,000 tons on the draft on which she was ordinarily run, although on a draft of 30 feet she would have displaced 32,160 tons. She was driven both by paddle wheels and by screw propellers. Her paddle wheels were enormous affairs, 56 feet in diameter; they were driven by a pair of two-cylinder, oscillating engines of 14 feet stroke. The screw propeller was driven by horizontal engines, and the combined indicated horse power of all engines was 8,000. Her maiden trip was made from Southampton to New York, in 1860. The highest speed during the trip was 14½ knots an hour, and the longest day's run 333 miles. Although she was a failure commercially, she proved invaluable by successfully laying the first Atlantic cable in the year 1866. She laid two more Atlantic cables in 1873 and 1874, and finally, in 1888, she was sold and broken up at Liverpool.

For several years the Inman line, now the American line, had been using the screw in place of the paddle-wheel, with very satisfactory results, and consequently the next vessel built by the Cunard Company, the "China," was of the screw-propeller type. She was considerably smaller than the "Persia," as the dimensions show, and her speed was about the same. It was about this time that the compound engine with its higher steam pressure and superior economy began to make its appearance. Simultaneously came in that era of long and narrow ships which was destined to

Date.....	1840	1850	1855	1858	1862	1874	1881	1884	1889	1893	1897	1899	1900	1901	1901	1903	Date
Length on Deck...	215′	275	385′	692′	337′	435′	530′	525′	560′	620′	649′	705′	686′	700′	663′	707′	Length on Deck.
Beam	34′ 4″	40′	45′ 3″	83′	40′ 5½″	42′ 3″	52′ 3″	57′ 3″	63′	65′ 3′	66′	68′	67′	75′	66′	72′	Beam.
Moulded Depth	24′ 4″	27′ 2″	31′ 6″	58′	29′	36′	40′ 9″	40′	42′	41′ 6″	43′	49′	44′	49′	43′	43′	Moulded Depth.
Displacement in Tons	1,731	3,340	4,950	28,000	3,808	6,834	11,088	12,190	15,000	19,425	21,000	32,500	23,500	37,700	21,300	27,000	Displacement in Tons.
Indicated H. P...	740	2,400	4,000	8,000	2,250	3,250	9,900	14,500	20,000	30,000	31,000	28,000	37,500	14,000	37,000	38,000*	Indicated H. P.
Speed in Knots.	8.5	12.5	13.8	14.5	13.9	13.8	16.7	19.6	20.7	22.1	23.0	20.7	23.5	16.0	23.27	23.0*	Speed in Knots.



* This is the contract horse power and speed; likely, as in the "Kronprinz Wilhelm," to be greatly exceeded when the ship is in service.

GROWTH OF THE TRANSATLANTIC STEAMSHIP FROM 1840 TO 1903.

play such an important part in the history of the steamship. The "Bothnia," built in 1874, was a compound, single-screw vessel which may be taken as thoroughly typical of the fashion of the day; with a length of 435 feet, her beam was only 42 feet 2 inches, giving a ratio of length to beam of nearly 1 to 10. She was 36 feet in molded depth and of 6,834 tons displacement. Her speed, however, was only 13.8 knots an hour, or the same as that of the old paddle-steamer "Asia" of nearly twenty years earlier date.

Between the "Bothnia" and the "Servia" the development of the steamship passed through perhaps its most important stage; for, with the introduction of the Bessemer process of steel manufacture, it became possible to turn out steel which possessed the necessary qualities for shipbuilding and was at the same time moderate in price. The first steel steamer built for the Cunard Company and the largest and most powerful ship (except the "Great Eastern") ever constructed up to this time, was the "Servia," which took her place on the Atlantic in 1881. This vessel was the wonder of her day. She was 530 feet long on deck; 52 feet 3 inches in beam; 40 feet 9 inches in depth, and she had the great displacement of 11,088 tons. With her three-cylinder, compound engines of 9,900 horse power, she maintained an average speed of 16.7 knots an hour across the Atlantic. The last and most famous of the single-screw steamships were the "Umbria" and "Etruria" of the same company. In these vessels we see a return to a more moderate proportion of beam to length. With 5 feet more beam the "Umbria" was 5 feet shorter over all than the "Servia" and her molded depth was about 9 inches less. Her displacement was 12,190 tons. Her engines, the largest single-screw engines ever put into a steamship, indicated 14,500 horse power. She maintained a speed of 19.6 knots an hour for the whole trip across the Atlantic. The "Umbria" was the first transatlantic steamship to make the trip in less than six days. In July, 1892, she covered the distance in five days, twenty-two hours and seven minutes, at an average speed of 19.6 knots an hour.

To the Inman and International line belongs the credit of producing the first twin-screw transatlantic steamers, the "City of Paris" and the "City of New York." These ships are 560 feet in length over all, 63 feet in beam, 42 feet in depth and the displacement is 15,000 tons. The twin-screw, triple-expansion engines have each indicated as high as 10,000 horse power, making a total of 20,000, and the "City of Paris" has the credit of making the trip across at an average speed of 20.7 knots an hour. These magnificent ships introduced many new features, one being their great breadth in proportion to their length and another the remarkably handsome dining saloon placed forward of the engines. They now belong to the American line, and have been changed by the substitution of quadruple-expansion for triple-expansion engines, with the result that the coal consumption has been reduced from 320 to 270 tons per day, the speed remaining about the same. In 1893 the Cunard Company again took the leading position with a pair of steamships which were the first to exceed 600 feet in length. The "Lucania" and "Campania" were designed to be considerably the fastest vessels afloat and to this end engines of 30,000 horse power were provided. From the very first they were a great success, and the "Lucania" was the first steamship to cross the Atlantic at a speed of over 22 knots an hour, her speed for the whole trip being 22.1 knots.

Five years later the North German Lloyd Company put in service a type of vessel which has been very closely followed by the German companies in the later ships which they have built. The "Kaiser Wilhelm der Grosse" was 649 feet long, 66 feet in beam, and 43 feet in depth. She was the first vessel to exceed 20,000 tons in displacement. Her horse power is greater than that of the "Lucania" and she has steadily added to her speed during the time she has been in service. Her fastest passage was made at an average speed of 23 knots an hour. She carries four smokestacks and presents an extremely handsome and rakish appearance. The four funnels are a feature which distinguishes the later German liners from those of other fleets. In 1899 the White Star line, whose vessels have always been justly famous for comfort and regularity, determined to build a first-class liner which should greatly exceed in size anything that had yet been constructed. On every point of comparison, except that of horse power and beam, the "Oceanic," as she is called, surpasses every previous vessel, not even excepting the "Great Eastern." She is 705 feet in length (the "Great Eastern" was several feet shorter than 700), 68 feet in beam; 49 feet in depth, and on her maximum designed draft of 35 feet she will displace 32,500 tons. She is thus, it will be seen, vastly greater than any previous vessel. With 28,000 horse power she has made an average speed for the whole trip of 20.7 knots an hour.

The next famous vessel, the "Deutschland," of the Hamburg-American line, was built at the Vulcan yard, Stettin, by the same firm that turned out the "Kaiser Wilhelm der Grosse." She is an enlarged and more powerful edition of that vessel. Her engines, designed to give 33,000 horse power, actually developed last year 37,500 horse power for a whole trip across the Atlantic, and on that occasion she maintained an average sea speed of 23.5 knots an hour. The next notable ship, the "Celtic," of the White Star line, is remarkable for her great bulk. She is of the combined passenger and freight type that is so popular and profitable in these days. Of about the same length and depth as the "Oceanic" she has the great beam of 75 feet, and with her fuller lines it is not surprising to learn that her displacement on her maximum draft of 36½ feet is 37,700 tons. She made her appearance early in 1901. In the fall of the same year the North German Lloyd Company dispatched on her maiden voyage the "Kronprinz Wilhelm," another product of the Stettin yard. She is intermediate in size between the "Kaiser Wilhelm der Grosse" and the "Deutschland," but resembles them greatly in other respects. Her contract horse power was 33,000, but she has actually developed 37,000 under favorable conditions. Her best average speed at the present writing is 23.27 knots an hour, but in view of her performance on several occasions, when the weather has been favorable, it is expected that she will about equal the speed of the "Deutschland" before the season of 1902 is over. There is now nearing completion at the Stettin yard, for the same company, a vessel which is to be the longest and fastest, though not the largest, in the world. She is known as the "Kaiser Wilhelm II.," and her dimensions are as follows: Length over all 707 feet, beam 72 feet, depth 43 feet, displacement 27,000 tons, and contract horse power 38,000. Judging from the excellent performance of the engines of the previous boats turned out by these builders, it is likely that the engines of the new "flier" will develop between 42,000 and 43,000 horse power and that her speed will reach the 24-knot mark.

An announcement has recently been made of the purpose of the Cunard Company to place two more liners on the Atlantic route which shall exceed, in speed at least, any previous vessels. The ships do not appear in our diagram for the reason that the details of length and size have not yet been determined upon. An interesting feature of these ships is that they will probably be equipped with turbine engines of from 47,000 to 50,000 horse power, and that the contract speed will be 24 knots an hour.

Summing up this brief review of the growth of the transatlantic ship during the past sixty-two years, we note that the length has gone up from 215 to 706 feet, the beam from 34 feet 4 inches to 75 feet, the depth from 24 feet 4 inches to 49 feet, and the displacement from 1,731 tons to 37,700 tons; while the horse power has increased from 740 to 37,000, or about fifty times, and the speed has been trebled. As to passenger accommodation the growth has been marvelous, for whereas the "Britannic" of 1840 could give indifferent accommodation to only 90 passengers, the "Celtic" can carry 3,194 souls, of whom 2,859 would be passengers.

America's Greeting to Lord Kelvin, the British Scientist.

Lord Kelvin and Lady Kelvin, who arrived in New York on the 19th ultimo, were tendered a reception at Columbia University on the evening of April 21st by Columbia University, the American Institute of Electrical Engineers, the American Association for the Advancement of Science, the American Physical Society, the American Mathematical Society, the Astronomical and Astrophysical Society of America and the New York Academy of Sciences, which was very largely attended. A most cordial feeling prevailed for Lord and Lady Kelvin who were the central figures of the evening, surrounded on the large platform by many prominent scientific men. Dr. Francis B. Crocker presided and introduced President Nicholas Murray Butler, the new president of Columbia University, who extended to Lord Kelvin an entertaining address of welcome. Prof. Elihu Thomson spoke of the remarkable clearness of Lord Kelvin's expositions of difficult electrical problems. He was easily understood because he fully understood the subjects he explained. He was the father of electrical engineers. He not only explained theories, but also designed apparatus to carry them into effect. His calculations were so accurate that he was able to predict in advance the kind of submarine cable that would be operative. His reflecting galvanometer, and later his simple but effective siphon-recorder for the recording of cable messages in ink were prominent examples of his inventive genius, which were now in use all over the globe. Having done so much in the promotion of cable telegraphy, it was fitting the invitation to attend the reception should have been sent to him one hundred miles out to sea by wireless telegraphy, the most modern form of communication, and that his acceptance should be returned in the same way.

Dr. Arthur Gordon Webster, for the American Physical Society, welcomed Lord Kelvin as one of the most advanced scientific thinkers. He possessed a trained imagination, which was of great assistance in evolving explanations of the problems he had to contend with. It was the moral and financial support of Cyrus W. Field, in the early days of the cable and cable construction, that became an incentive to Lord Kelvin to master the difficulties that were then presented.

It was Kelvin who predicted the possible conversion of the great power of Niagara into electrical energy. He was a man of singular activity in scientific investigation and was still busy in his laboratory when at home. He was most cordially welcomed, and the best wishes of all were extended to him.

Dr. Robert Simpson Woodward, in behalf of the American Association for the Advancement of Science and other scientific bodies, gave a brief address of welcome strongly eulogistic of Lord Kelvin's scientific attainments. Upon its conclusion, Lord Kelvin arose to respond and was given a rousing welcome by the whole great company of some two thousand rising and enthusiastically applauding for a few minutes. He said in part:

"I am not much of a speaker, but he would be poor in speech, indeed, who could not find words to thank you heartily for this splendid reception. This meeting is not only a meeting of welcome to a citizen of another country, but I may see it is a union of the sciences, and to scientific men such an occasion is always memorable.

"Some kindly references have been made by some of the speakers to the little I was permitted to do in connection with the laying of the Atlantic cable. That was a great work and a great monument to a great American. Others helped in the work, but Americans must never forget, as the world will never forget, the name of Cyrus W. Field." (The mention of his name caused great applause.)

Lord Kelvin then described the cable of 1858, which operated only for three weeks, the various disappointments that followed the final completion of the successful cable in 1865, of its breaking in two, and the difficulties encountered in grappling for it and its final repair, and how he acted as assistant electrician to Mr. Varley on board the "Great Eastern" in its completion. He then continued: "Science has advanced greatly during the years along all lines, and one of the greatest achievements is that of Marconi and wireless telegraphy. It is a great achievement to send a message inland from 100 miles out at sea, or for several hundred miles. The work that he has done indicates that the time will come when messages will be sped over the ocean without an intervening wire. But, my friends, we must not forget the great achievement which gave us sub-marine telegraphy, which will continue to serve us well even with wireless telegraphy as a commercial success.

"As I said before, Americans of all others, must not forget the work of Cyrus W. Field. I always got inspiration from the time I first came to America. The first time I landed on this continent was in 1866, and my landing was in Newfoundland. One might not believe it, but I got wonderful inspiration from Newfoundland. Ten years later, I came over to your Centennial Exposition and America had given to the world then a triumph of science in the telephone. I got inspiration on that visit from meeting and talking with Alexander Graham Bell.

"The next time I came was in 1884 and then I found the great achievement of Edison perfected, and New York as bright by night as by day through his invention." Great applause here interrupted the speaker, which did not subside until Mr. Edison rose and bowed his acknowledgments.

Lord Kelvin spoke finally of the inventions which made possible the transmission of power at high voltage and the harnessing of Niagara. Of this he said:

"Beautiful as that wonderful work of nature is, it would be more beautiful still if those waters fell upon turbine wheels every one of which was turning the wheels of industry."

After the address the audience walked across the stage and shook hands with Lord and Lady Kelvin.

An unusually interesting discovery has been made at Stanford Bishop, England. Dr. James Johnson, the eminent antiquarian, has found an old oak chair in the village church, which is said to be the most perfect example of ancient British carpentry extant. It is believed to have been used by St. Augustine at the synods held between A. D. 590 and 603. The chair is made entirely of oak, without any form of iron work. It is oblong in shape, the outside measurement being 32 inches in length and 22 inches in width. Four massive posts, with two boards on each side mortised into them, form the supports. The seat is 26 inches in length and 18 inches in width, and appears to have originally been 2 inches in thickness. It is movable like the lid of a box; the hinges being two round tenons inserted into mortise holes in the rear posts. The construction of the chair is similar in many respects to a Roman solium, or chair of authority.

UNDERGROUND ELECTRIC RAILWAYS ABROAD.

BY FRANK C. PERKINS.

Underground electrically-operated railways have been running in Europe for a number of years, and at the present time the large cities in this country are taking up this problem with a great deal of energy and with every prospect of great success. The New York Rapid Transit Tunnel is well under way and when completed will give this city one of the finest express electric railway services in the world, greatly relieving the crowded down-town elevated and surface systems. The Boston subways are now being extensively used and a new tunnel under Boston Harbor will serve both the elevated and surface electric lines. In London and Paris underground electric roads have been in use for quite a long period with great success, and although some of the disadvantages of the small-tube tunnels have been quite serious, they are now being overcome in the larger subways and tunnels being constructed in this country as well as in Europe.

The terrible collision in the tunnel of the New York Central, where steam locomotives are employed (due to the smoke and inability to distinguish signals), shows up the advantages of electric propulsion for this class of travel so well that undoubtedly this and other tunnels now using steam will soon be equipped with electric apparatus.

The Liverpool catastrophe, where a train was burned and several lives lost in one of the tubular tunnels operated by electricity, also shows that accidents are possible, unless the greatest precautions are taken, in the electrically-operated tunnels. The creosoted sleepers were burned and the train, although a low-tension current was used, was destroyed. It is stated that the Liverpool line has its motors at the ends of the train connected in series, the whole current passing from one end of the train to the other, while the Central London trains are operated by electric locomotives, or by motors, also at the ends of the trains, but worked in parallel, only a small controller current passing the length of the train. The small-tube railways are criticised as most dangerous when a breakdown occurs in the tunnel, as the trains fit the tunnel so closely. In order to allow the passengers to get out at the side in case of a breakdown, a much larger diameter is required, which increases the cost by many millions of dollars, since the amount of excavation increases rapidly as the size of the tunnel increases in diameter.

The tendency is to use larger tunnels in this country as well as in Europe in the most modern construction, even at an enormous increase in cost. The subways and tunnels in Buda Pesth and Berlin are of particular interest as the former represents an installation which has been in successful operation for some time, while the latter is just being completed and is of much importance on account of the close connection it has with the elevated railways in that city, the combination of an underground and overhead structure proving a most practical solution of the rapid transit question in Berlin.

Our illustrations of the Buda Pesth underground electric railway show the street entrance as well as the interior of one of the subway stations, one of the electric motor cars, and the entrance to the tunnel with the overhead electrical conductors in view. The entrance and stairway herewith shown, are located at the station Franz-Deak-Platz, and the underground station is situated at Octogonplatz. The tickets are sold at the stations and collected on the trains, which make a complete run in about 10 minutes, the speed being from 20 to 30 kilometers per hour. The cars are constructed of a height to best utilize the size of the tunnel, fitting the same with as little clearance as possible with safety. The overhead devices for conveying the current from these conductors to the motors of the cars are seen in the illustrations. These devices, which take the place of the trolley pole and wheel, are mounted one at each end of the car, the springs and levers as seen being placed at the side of the car frame. Along certain parts of the underground line bare feeders are run on insulators on the roof of the tunnel.

There are special circuits run for signals, light and telephone service, all of which are carefully laid to insure safe running of the trains. Electric incandescent lamps with double reflectors are used throughout the subway at distances of from 10 to 20 meters apart.

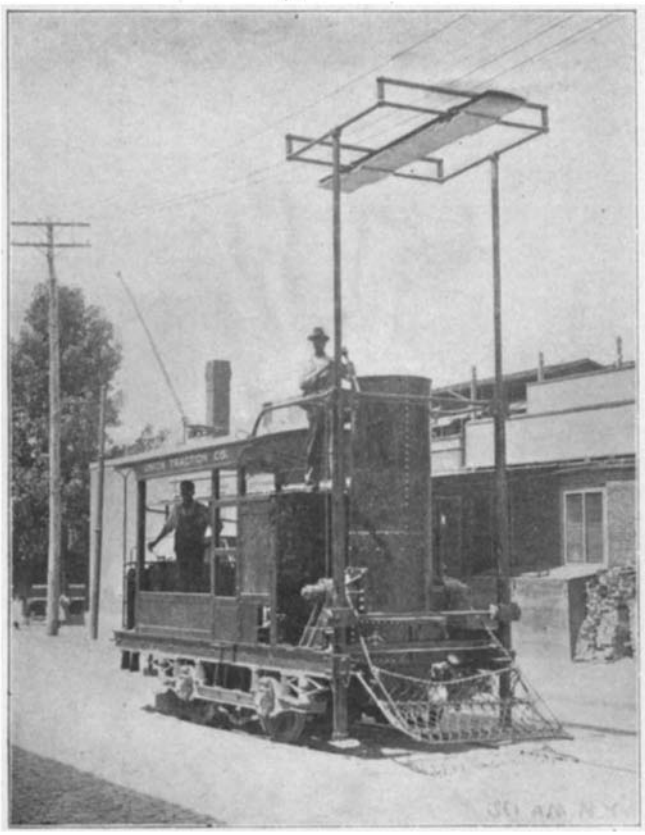
The line of tunnel is about 4 kilometers long, the inner clearance breadth being 6 meters and height not quite 3 meters, iron columns separating the tracks, as in the case of the Berlin tunnel. These iron columns rest on stone foundations and are about 4 meters apart.

As will be seen from the illustrations, on the top of the columns and running along the tunnel are placed I-beams from 0.32 to 0.35 meter high, these supporting the transverse I-beams, which have their ends resting on the side walls. These I-beams are placed 1 meter apart. The space between the beams, as seen in the illustration, is filled in with beton, and the whole tunnel is surrounded with asphaltum felt. The cars seat 28 passengers and have standing room for nearly as many more. They are 12 meters long, a trifle over 2 meters wide, and each is equipped with motors of 100 horse power.

This construction of motor cars contrasts very strongly with the latest type of underground motor cars used on the Berlin elevated and subway line. The trains in the Berlin tunnels consist of three coaches, the two end ones only being equipped with motors. The total number of passengers per train is 120 to 130, and the whole train weighs 72 tons, each car weighing about 24 tons. The cars are mounted on two trucks of two axles each, the motor axles being connected by single reduction motors wound for 750 volts. These motors take a current of 1,000 to 1,200 amperes at this potential, driving the train at a rate of 30 kilometers per hour. The cars are 12.7 meters long, 2.36 meters wide and 3.18 meters high. The trains have a 5-minute headway and pass through the city of Berlin nearly east and west from the Zoological Garden to the Warsaw Bridge.

Some of the details of construction of this subway were given in the SCIENTIFIC AMERICAN, page 84, vol. lxxxiv., No. 6, as well as information in reference to the route. The stations are reached by means of stairways which are supplied with ornamental balustrades, and as the depth is only 3.5 meters the stations are easily reached without fatigue. The stations are well equipped and agreeable, being brilliantly lighted by electric lamps and lined throughout with cream-colored porcelain tiling. The height of the Berlin tunnel is 3.3 meters above the rails, while the total width from wall to wall is 6.25 meters; at the curves the tunnel is much wider.

The gage of the rails in the Berlin tunnel is 4 feet



REPAIR CAR.

8½ inches, and the current is taken off from the third rail by means of a shoe indicated in Fig. 5 showing one of the cars.

The tunnel is constructed of cement, with 1-meter walls. It is made water-tight with asphalt felting, which has proved so effective in the Buda Pesth subway. The roof is supported by iron I-beams 1 meter apart resting on the side walls and iron columns in the center similar to the construction described above for the Buda Pesth tunnel. Between these beams cement arches are constructed and leveled off on top by means of a layer of cement, above which is laid a water tight covering of asphalt felt, and above this the pavement.

The Boston Harbor tunnel is an arched monolithic concrete structure for two electric railway tracks and is much larger than the Berlin or Buda Pesth subways. The Boston Harbor tunnel is 20 feet 6 inches high and 23 feet 4 inches wide inside, and a 2-inch space has been reserved inside for a porcelain or other finishing treatment to give a more pleasing appearance. The arches and walls of this tunnel are 33 inches and the invert 24 inches thick.

The rails used in the Berlin tunnel are 180 millimeters in height and weigh 43 kilogrammes per meter length. The rails are laid directly on the girders without the use of sleepers, and are unsupported for 1.5 meters. Hardwood blocks are used to insulate the rails from the iron structure, and between the rails and the wooden blocks layers of felt are used.

A pumping engine in a Birmingham Canal station was recently removed after having been in continuous use for 120 years.

Engineering Notes.

The effect of machinery on wages is well exemplified by the following figures: At one time in the United States a roller in a rail mill, rolling iron or steel rails, received about 15 cents per ton, turning out from 75 to 100 tons per turn. To-day, on some of the modern steel rail mills less than 1 cent per ton is paid for doing the same work, and yet by the end of the year the roller in the rail mill can make as much money as he did under the old method of working. At one time 45 cents per ton was paid for heating iron for making iron rails. To-day, through the use of the improved methods, very little more than ½ cent per ton is paid for doing the same work, and yet the wages received are better than they were at that earlier time.

In a dispatch to the British Foreign Secretary, dated December 31, covering a number of reports received from railroad officials, the British diplomatic agent and consul-general in Egypt, Earl Cromer, draws the general conclusion that the main reason why so many orders for railroad plant have recently been given to the United States is that the American firms have been able to execute them with extraordinary rapidity. Where special designs are required Earl Cromer finds that the British firms can hold their own. In quality of workmanship the British locomotives are said to be superior to those of America and Belgium, while in the consumption of coal they are superior in economy to the American engines, though not over the Belgian. It is said that a series of trials of American and British freight passenger engines conducted by a representative of the Baldwin Locomotive Company and a locomotive inspector of Egyptian railroads show that the American freight engines consume 25.4 per cent more coal than the British, while the latter drew 14.2 per cent more load. With the same load the American passenger engine consumed 50 per cent more coal than the British. No doubt these figures are correct. But the question always remains, have the American locomotives been operated as they would be operated in America, to their utmost capacity?

Nickel-steel alloy of 36 per cent nickel has the least coefficient of expansion of any known metal, being only one-thirteenth that of iron, or about 0.0000005 for 1 deg. F., says Machinery. This remarkable freedom from variation of length under a variation of temperature has caused the quite general adoption of nickel-steel of about the stated percentage of alloy for the pendulum rods of high-grade clocks. With the nickel-steel rods no means of compensation for variation of temperature is necessary, the slight changes in the brass bob compensating for the changes in the length of the rod. Nickel-steel also has the valuable property of resisting oxidization or rust to a remarkable degree. It may be exposed for weeks to conditions which would quickly coat ordinary iron or steel with a thick coating of rust, without showing more than minute specks of rust. If nickel should ever be discovered in quantities sufficient to greatly cheapen its present cost, it would have an important influence on future steel construction, as nickel-steel would be generally used because of its toughness, superior strength and freedom from rust, the great disintegrator of modern iron and steel structures. Railway rails having an alloy of 36 per cent of nickel would require practically no allowance for expansion between the ends, since the total expansion of a mile of track from 20 deg. below zero to 100 deg. F. would be only 3.8 inches.

The Current Supplement.

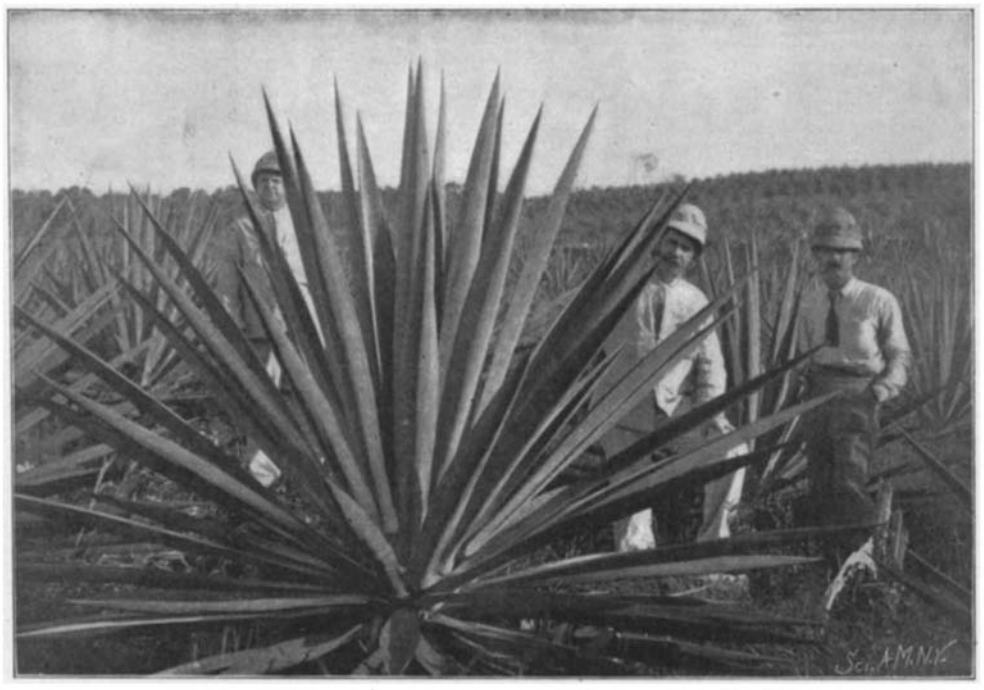
Little enough is known of the engineering work done in the Far East. For that reason an illustrated article in the current SUPPLEMENT on the headworks of the Mandalay Canal built for irrigation in Burma should prove of considerable interest. Mr. Walter F. Willcox, chief statistician of the methods and results of the Twelfth United States Census, tells how the United States government estimates the millions by which our population is numbered. How accidents are scientifically studied has been made the subject of an article by Dr. J. Howe Adams. Some curious types of bicycle brakes are described in an article which is illustrated very fully. A discussion of the sanitary condition of New York streets is a matter that deserves attention; for that reason an article on the subject is rather timely. Perhaps the most important article in the current SUPPLEMENT is an admirable account of electrical furnaces by Bertram Blount. The article comprises several installments which will appear serially in the SUPPLEMENT, and is very fully illustrated by the best known types of furnaces. A very elaborate account of artificial limb-making narrates curiously and interestingly the history of a strange craft. The usual Consular Notes will be found in the SUPPLEMENT.

The German Naval Department has contracted with the Vulcan and Germania shipyards for two battleships, each of 13,000 tons displacement, which must be ready for service in 1906.

THE SISAL INDUSTRY IN THE BAHAMAS.

BY S. HARBERT HAMILTON.

While on an exploring expedition through the West Indies your correspondent made a point of carefully inquiring into the sisal business. To this end the largest plantation on the island of New Providence was visited. This is the property of Mr. F. M. Menendez, who kindly furnished most of the following facts. Considerable judgment has to be exercised in the selection of land, which is worth from $5 to $15 an acre. The young plants are set out at intervals of several feet. They are usually quite tiny—not larger than one's hand. In three or four years the leaves have attained a length of three or four feet. Now the harvest is ready. All the outside leaves are cut off close to the ground, leaving three or four around the center. The shining green blades are loaded into carts and hauled to the factory. Here an interesting process commences. The heavy green leaves are fed into a machine, driven by a 24 horse power oil engine. Two rapidly revolving wheels set with brass knives quickly tear the green pulp from the strong fiber. The pulp is washed away by about a thousand gallons of water running through the machine per hour. Each leaf contains but from 3½ to 4 per cent of fiber; as the leaf is only in the machine a few seconds it is possible to make with this equipment about three-quarters of a ton a day. From the machine the wet fiber is carried to the drying grounds, where it is allowed to bleach in the sun. When it is dry it is brought into the warehouse in masses of shimmering white fiber, 3 or 4 feet long. Here it is baled under a pressure of some thirty tons in bales of four or five hundred pounds, to be shipped to twine manufacturers in the States.



A SISAL PLANTATION.

In examining the sisal fiber, a single strand of which will sustain a strain of nine pounds, it seems that surely some use could be devised for it which would insure a market price of more than 9 cents a pound. At first sight one would imagine that it might be woven like flax; a more careful study shows that the diameter of the strands varies from butt to tip of leaf. It does appear, however, that the shorter and poorer qualities which bring but 5 cents a pound could be used to give strength to shoddy, and in preparing an untearable paper.

Over 95 per cent of the sisal plant being waste, it is immediately suggested that the huge piles of green refuse lying about the works should be put to some use. This is done to some slight extent by using it as a fertilizer. An analysis of the ash of some of the material showed it to consist largely of carbonate of lime and magnesium, with 6 to 7 per cent of potassium salts—a valued constituent of fertilizers. Mr. Menendez at the present time has chemists investigating this refuse, and it is possible, as it readily ferments, that this waste product may prove a valuable source of both alcohol and acetic acid.

MECHANISM FOR PREDICTING THE TIDES

BY DAY ALLEN WILLEY.

The machine for predicting the tides for a given period, used by the United States Coast and Geodetic Survey, is the invention of the late William Ferrel, who was connected with the service. It will make predictions two and three years in advance, as desired, and one machine is so arranged that it will make the necessary mechanical calculations for all of the American seaports, as well as for some of the more important foreign harbors. In constructing it, the inventor utilized data or components of tide observations which had been gathered for a period of years, and arranged the parts to correspond with various lunar changes and other phenomena which affect the tides. Briefly described, the device is a mechanical computer which solves the geometrical problems arising in this division of government labor.

The tide predictor performs its work with such accuracy that comparison of its records with observations taken at tide occurrence show its greatest deviation to be less than three-tenths of a foot and the variation in time seldom more than five minutes. As a substitute for human labor it is estimated that the machine does the work of fully forty mathematicians.

In the construction of the machine, two brass plates, 16 inches wide and 22 inches in height to support the wheel work, are placed in a vertical position about 2.5 inches apart, the edges of which are seen in Fig. 2, which is a side view of the machine. Nineteen of the principal components or estimates are provided, each component being represented by an individual axle connected with a crank and pulley. All of these axles are connected with what might be termed the operating axle, which is located in the lower part of the predictor, and is moved by the crank seen projecting from the left hand side of the case. The small chain fastened to the pulley on the right hand side of the case (Figs. 1 and 2) passes over all of the pulleys of the several tide components connecting with the sliding frame seen in Fig. 1 on the right side of the case. A second chain also passes over the pulleys representing the tide components, and with the one already noted is used to adjust or set the machine for prediction for a certain port. In making the adjustment it is necessary to use the triangle in geometrical calculation. This is completed by the action of the chains upon the sliding framework seen in Fig. 1 at the left of the two vertical indicators or scales. The slit in the bar of this framework determines the sides of the triangle.

All of the machinery is moved with the left hand by means of the crank represented on the left side of the machine. This crank turns the horizontal axle passing from side to side, most visible in the lower part of the front view. By means of a connection between this axle and two upright shafts, one of which is seen in Fig. 2, the one on the left is made to turn twice in a lunar day, and the one on the right, once in lunar day. By means of a connection of three wheels and an endless screw between the shaft and each of the axles of the semi-diurnal tide-components, which are all arranged on that side, each of these axles is made to turn in its proper relative period with regard to that shaft.

The index on the dial, Fig. 1, pointing to the left a little below the figure 9, is the lunar index. The other index pointing to 11 is the solar index, which indicates the solar time. When this points to 12, and the small index directly below the center points downward, it is midnight; but if the small index points upward it is noon. Although the lunar index moves according to lunar mean time, yet it does not point out this time on the dial, but indicates the phases of the mean lunar tide, and the high water of this tide occurs when the index points to 12. It consequently points out the lunar time which has elapsed since the last high water of the mean lunar semi-diurnal tide.

The longer index, in the upper left-hand corner, Fig. 1, moves around the circle in three hundred and sixty-five days, and keeps a record of the day of the year. Between the other end of the axle which controls this index and the axle of the small toothed wheel between the two scales on the left of the face of the machine, there is a connection by means of a small crank and a rod which turns the latter axle a little, by which the annual inequality of mean level of the sea is taken into account. During one part of the year the left scale is thrown down a little and the other up, the effect of which is to increase the readings of both high and low waters. During the other part of the year the effect is the reverse. The smaller index is used in setting the axle and crank in accordance with the epoch of maximum of this annual irregularity. The index of this and the indices of the other three dials in the other corners are controlled by means of connections between their axles and the horizontal shaft below, turned directly with the left hand by means of the crank attached to it. The thermometer is no essential part of the machine, but is placed there because it is a convenient place to keep a thermometer to give the temperature of the room, also, because it gives symmetry to the face of the machine.

After the machine has been "set" to make predictions for a certain port, the operator first turns the crank with the left hand until the lunar index comes in conjunction with one end of the needle pointing between 12 and 1 on the center dial in Fig. 1. If this is the upper end, the solar index then

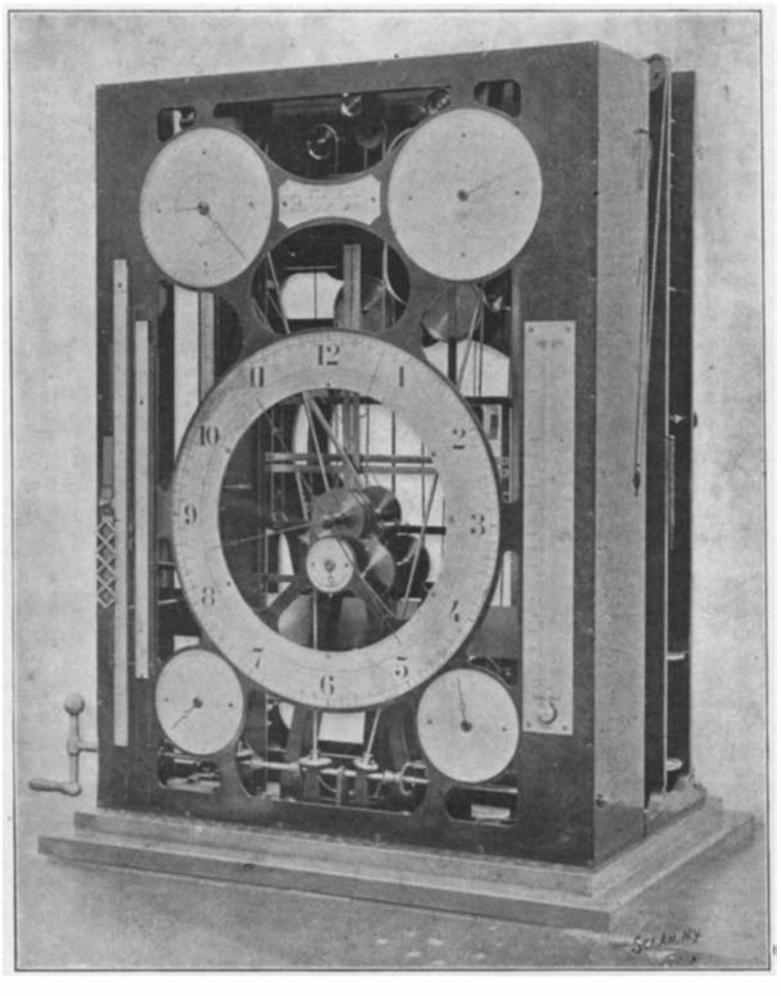


Fig. 1.—TIDE-PREDICTING MACHINE; FRONT VIEW.

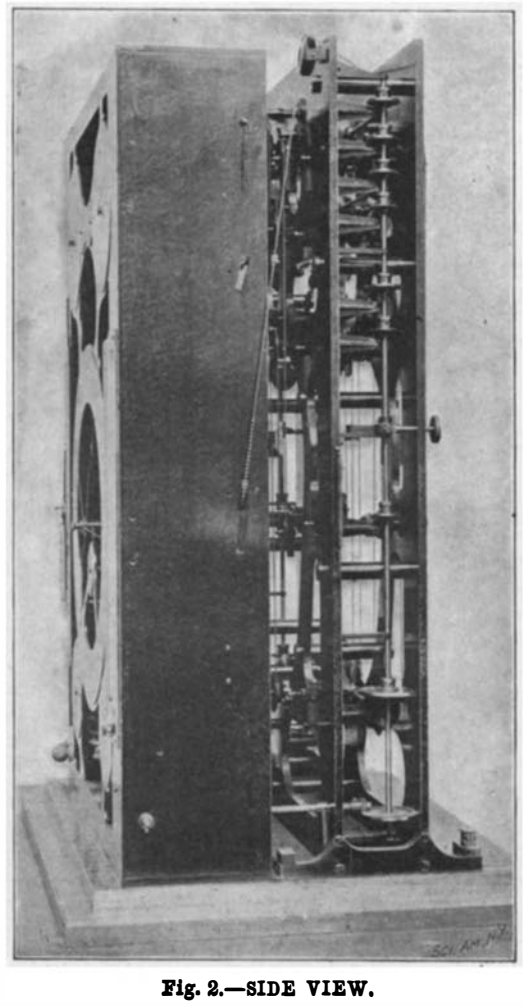
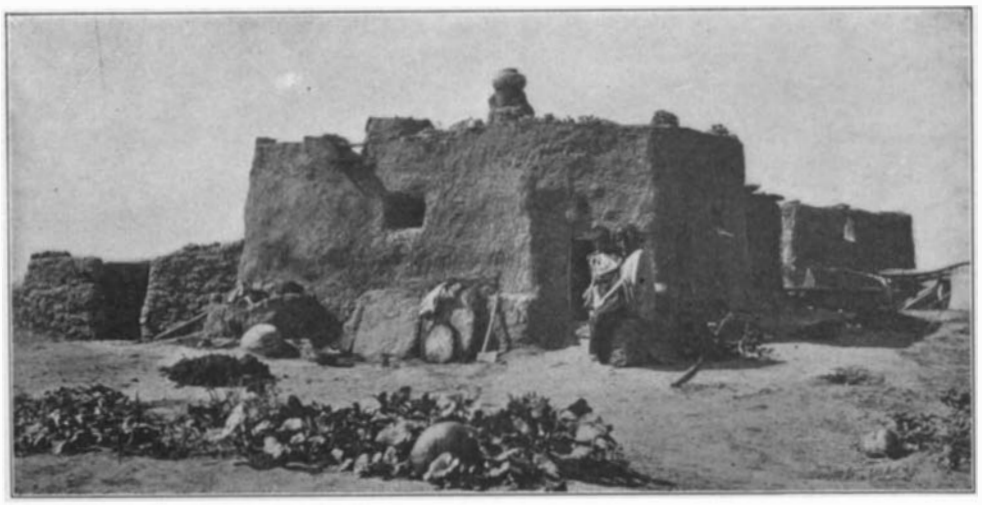


Fig. 2.—SIDE VIEW.

points out the time of the first high water, and the index on the left hand side of the face of the machine, read off on the left part of the scale, gives the height of this high water. Then by turning until the lunar index comes in conjunction with the lower end of the needle, the time of the next low water is given. The solar index points out the time of this low water, and the index on the side, read off now from the right hand part of the scale, gives the height of this low water. Turning until the lunar index comes in conjunction again with the upper end of the needle, gives the time of the second high water, the height of which is read off as before. Thus the computation is made through the year from high to low and from low to high water, by reading and recording the results as read off. Where the range of the mean tide is less than about 5 feet, as is the case mostly on all stations south of Cape Cod, the pulleys on the cranks can be thrown out to double the distance of the amplitudes, and the heights then read from the inner graduation of the scales, which is two inches of the scale to a foot of tide.



EXTERIOR OF A PUEBLO HOUSE, ZUNI.

DISTANT VIEW OF THE TOWN OF ZUNI

ZUNI, AN ANCIENT CITY OF THE PUEBLOS.

High up on the western slope of the Sierra Madres, between 7,000 and 8,000 feet above sea level, stands Zuni, the ancient city of the Pueblos. Silhouetted in red against the clear blue sky, with a background formed of the turquois-tinted mountains, and in the nearer distance, across the precipitous valley of Ta-ai-ia-lo-ne, the sacred thunder mountains of the Pueblos, this city of the past is a picture that takes more than ordinary pen or brush adequately to describe. The terraced buildings are the color of the Sierras and are built of it—red sandstone slabs mortared together with red adobe clay—and their square, fortress-like appearance gives to the town a truly commanding aspect. There is nothing else in the world like Zuni, for without, and from within, it presents a scene difficult to describe. There are narrow, winding ways, irregular-shaped plazas, all of which have characteristic names; while oddly-costumed figures are seen winding noiselessly through the streets, the women carrying on their heads great earthen jars of

THE TERRACED HOUSES OF ZUNI—A VIEW INSIDE THE CITY.

water, the last a feature suggestive of the Orient. There are ladders everywhere; for though the houses beneath have doors, those that form the superstructure are not entered through those below. Above all the roofs are seen numerous clay chimneys, built in sections, and looking for all the world like the graded array of pots in a china store; while, oddly enough, they form the flues for what are practically the counterpart of the great, old-fashioned New England fireplace. A single slab of stone placed above the fire serves as a stove. Tables and chairs there are none, but Pueblo and Navajo rugs and blankets curtain the walls and carpet the floors.

In intelligence the Zunis rank with the Toltecs, Aztecs and Incas. Like them they have always dwelt in fixed abodes. One commendable feature of this people is the high pinnacle upon which they place their women. With them the woman is no drudge, as she is with the other American aborigines. She is never allowed to do the degrading work of the field. She carries the water and attends to the home, which, by the way, is her own, and from which, is she is so minded, she has the right to turn away her husband. The Zunis are the strictest monogamists, and while it is true that there is no modesty, as civilization understands it, in Zuni, yet there is no immorality. The Zunis are sentimental in the extreme and marry at a youthful age. When a youth is wooing a maiden, he will go and sit before her with his back turned to her, and untwine his head cloth. She rejects him by softly stealing away, or accepts him by running her hands caressingly through his loosened locks.

While they possess no written language like their South and Central American contemporaries, they have an unwritten literature that has come all the way down from their mythical beginning, verbatim. The Zunis never forget. It may be that reliance on the written words is the cause of the inferior powers of memory of the lettered peoples. The Zuni bible has four different divisions or books and each book is divided into four chapters, as it were. Half a dozen of the brightest youths of each generation are selected to serve the less fortunate as their books. On the minds of these are written, beginning at the age of twelve, the words of the sacred book. With the common folk all this is Greek, for it is transmitted in original Zuni, old English as it were, in order that every single syllable may be preserved intact.

Once the Zunis were strong in numbers and fortresses, but disease has thinned them down, and they have also been reduced by privation, resulting in some measure from their own confinement in a barren reservation, to the present number of scarce a thousand souls. Of late years they have broken down the barriers of seclusion and exclusion, that were a marked characteristic of the race. Until 1878 only one white man had ever dwelt in the place, and his stay was made not of his own volition. He was a cross-country mail carrier who was taken in by the Zunis and nursed during a sickness. On his recovery he was not allowed to leave the city. After months of search the unfortunate postman was traced to Zuni, and only on demand from a battalion was he delivered up. The stories told of the Zunis by this man found their way to the East and led to a scientist who became interested in them giving his life to the fascinating study of these people. This was F. H. Cushing, of the Smithsonian Institution; whose voluminous report was not published until after his death. He left Washington for Fort Wingate in the latter part of the seventies, and in the fall ventured, usually unaccompanied, from time to time, to Zuni, and gaining their admiration and respect he was finally allowed to enter the tribe. He was adopted by one of the governors and was required to dress, grow his hair, and live as they did, the people even urging him to marry into their tribe in order that he might inherit his foster-father's high position. This he refused to do, but later, when he took six of the great Chiefs to Washington, he selected a white bride for himself, who also became a member of the tribe. The Indians were so much impressed with what they saw on their journey that they offered Cushing the highest position in the tribe. "The white men are gods," said one of them. "It is a pity they have to live by eating of the earth as we do."

Cushing returned to Washington after a stay of over five years with this remarkable people; but he had become completely invalided by the coarseness of the food and the various hardships he had undergone for the sake of science, and his death, which took place a year and a half ago, is attributed to these privations.

The Zunis are cruel in some respects, but in their intercourse among themselves they are courteous and would make admirable models for some of our civilized white communities. They never lose their tempers, nor do they discuss matters in violent tones. They consider it beneath their dignity to strike a fellow tribesman. The children are remarkably obedient, a fact which may be accounted for somewhat by their custom of killing the worst child in the village at a certain anniversary feast. They refuse to be taught to read and write, and the two school teachers that now dwell with them can do no more than train them to sew and perform various domestic duties. Nor will they take up our religion. Their religious dances of supplication to the various gods and their dances of thank offering are numerous, but the great dance of the year is one that is held under the full moon of the month of May.

In the morning the Mudheads appear. These are naked performers with great clay masks over their heads, who rush through the streets shooting arrows into the hides and furs and feathers that are thrown in front of them. Subsequently these serve as clowns to the dancers. As a substitute for the sacrifice of the child, which was, of course, prohibited by the United States government, a band of fantastically garbed priests rush through the streets, carrying long switches which they lay unmercifully on anyone they happen to catch. At noon a number of dances, in which every god is impersonated, take place in the colosseum-like dance place, in which the natives who are not participants sit and applaud. The woman from the moon, the echo god, and the sun god are the most interesting. The echo god follows every utterance of the others a brief space of time thereafter, and he does it wonderfully well.

A feature which speaks strongly in favor of this curious people is, that unlike the nomadic Indians, with which the people of the United States are more familiar, they are very cleanly in their habits, an extremely important point when we remember that the Zunis always live in fixed habitations. Their food consists of curious paper bread, which is made by pulverizing grain, making it into dough and spreading it with wonderful evenness over slabs of stone. The bread bakes very quickly and is rolled into shavings, in which form it is eaten. Locusts are gathered every morning at sunrise, enough being laid by for each day's needs. They are roasted to a rich brown color and eaten. At the foot of the mountain on which the city stands, is a small salt lake, and in the neighboring valley a peach orchard which produces very fine fruit. Indian corn and maize grow fairly well under the hands of the Zunis, and the government can confer no greater boon upon them than by doing some work of irrigation, or at least by the construction of reservoirs; for it is a fact that the "water god," who is their chief divinity, showers his blessing upon them barely once a year.

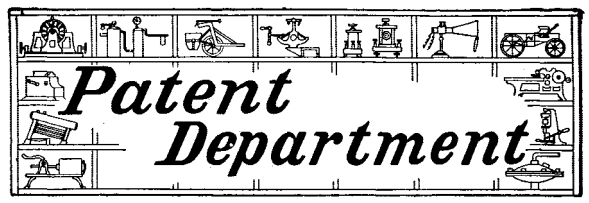
Weather Bureau Wireless Telegraphy.

The Weather Bureau has long been experimenting with suitable instruments for the transmission of wireless telegraphic messages. Recent experiments made by Prof. Willis B. Moore, the Superintendent of the Weather Bureau, have demonstrated the feasibility of the new apparatus which the Department of Agriculture will probably adopt. Prof. Moore stated that over water of wide expanse wireless messages could be sent accurately and quickly, and more rapidly than if wires were used; but that it was a matter of some doubt whether aerial communication would prove very successful on land. The Department used a new wireless receiver, in which a telephone is employed. The recent experiments showed that this apparatus operates faultlessly and rapidly. Prof. Moore states that he sent a message which, to be transmitted over a wire by electric telegraph, would require two or three minutes, and which was sent without wires at about the fastest rate of wire telegraphy over a land wire. What the particular construction of the Department's wireless telegraphic apparatus may be, has not as yet been disclosed.

Lord Kelvin on the Metric System.

The House Committee on Coinage, Weights and Measures, which is now considering the advisability of adopting the metric system in the various departments of the United States government, had two distinguished witnesses before it recently in the persons of Lord Kelvin and George P. Westinghouse. Lord Kelvin advocated the passage of the bill warmly. He remarked that he had long hoped that England would take the lead in this matter. If the United States were the first to adopt the system he had no doubt that England would soon follow suit. He was glad to see that the committee intended to allow a suitable time for the adoption of the standard before making it effective in order that the public at large might familiarize itself with metric terminology. Mr. Westinghouse also advocated this system.

Camden, N. J., will have a new shipbuilding plant soon, which will be quite as extensive as that of the New York Shipbuilding Company. The latter is situated at the lower end of the city, while the new one will be at Cooper's Point, which is at the other end of the city's water front. The plant of the Tway Machine and Blacksmithing Company has been secured, and the work of rearing the new shipbuilding plant will be begun at an early date. A marine railway, improved drydocks and the most modern appliances will be used.



PROPOSED AMENDMENT OF THE BRITISH PATENT LAWS.

The British press is at present quite a good deal exercised over the proposed amendments to the British patent laws. The object of the proposed changes is to so modify the existing laws of Great Britain as to place them upon a basis greatly resembling our present patent practice. It is designed by the proposed changes to establish a system of examination closely resembling the examination conducted by our Patent Office after an application has been filed. When any change in existing conditions is proposed in Great Britain, it almost invariably leads to a controversy, which is often conducted with more or less acrimony according to the degree of importance of the subject. The present instance is no exception, and it is with much of surprise that we note on this side of the water some of the objections offered to the proposed amendments. Some of the opponents claim that it is impossible to make a search which will be at all complete, and if such a search is not complete, it is of little or no value. It is contended by those who favor the bill that no search, however exhaustive it may be, can be absolutely complete, and that a search for fifty years through the patent records without doubt in many cases is not half complete, however carefully it may be made, but that such a search may be supplemented by an independent search on the part of the inventor if he wishes, and although the search may not be absolutely complete, that such completeness is only a matter of degree, but that it is desirable, although the result may not be absolutely determinate or infallible.

The great success which has attended our own practice with reference to the Patent Office search is, we believe, sufficient ground for the belief that the proposed legislation will be carried to a successful termination. The method of conducting an examination in the United States Patent Office is, in the main, very satisfactory. It is difficult to understand, however, how the British Patent Office will be able to carry out a sufficiently thorough examination for the small extra fee of $5 which it is proposed to charge for the additional work of making the examination. It seems doubtful whether the British Patent Office could be made self-supporting for the fee charged, if the examinations are conducted on a basis as thorough as that in the United States Patent Office.

Not long ago a deputation called upon Mr. Gerald Balfour with the object of having a clause inserted in the bill, which would necessitate the technical working of a patent within a certain definite period. The object of this feature of the bill would be to establish promptly a new manufacture, or to have the patent become void or voidable, owing to the failure to work the patent in the time prescribed. A recent issue of Engineering, in a comment upon these statements, says that "the legislation of practically every important industrial nation, save that of our own country, has a provision to secure this (working) either directly or indirectly." It then naively remarks that "in the United States the high tariff serves toward this end; while in many other countries there are provisions in the patent law for voiding a patent if it is not worked in that country." It will probably strike our readers as a matter of news that the high tariff serves to operate in the same manner as a working clause in other patent laws. We have been accustomed during the past forty years to hear all sorts of benefits or evils saddled upon the poor tariff statute, but this is the first instance in which we have heard a claim of this character put forward. It is certainly a most interesting and ingenious contention. The same article also puts forward the statement that "while giving our German friends every credit for the enterprise they have shown in establishing industrial research laboratories, there can be little doubt that they have also benefited greatly by their patent legislation, which helps their traders enormously by making patents voidable if not worked within the empire." We can hardly believe that the success of the German chemical industries is due to the fact that their patents become voidable after a failure to work them within the empire, and that the English chemical industry has languished owing to the fact that they have failed to establish a similar practice. We surely believe that such a condition of affairs has arisen from very different causes, from the same economic causes, in fact, which have enabled so many American industrial products to gain a firm foothold in Great Britain. One of the delegates, Mr. Joseph Lawrence, stated that "when the linotype machine was invented, fifteen years ago, he endeavored to obtain a license

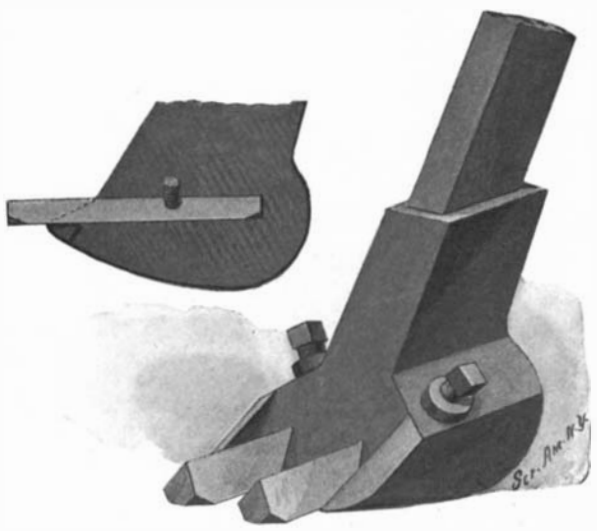
to manufacture in England. This was refused, and he was subsequently obliged to pay £800,000 for the British rights; while in Germany, the right to manufacture was sold on more advantageous terms, which enabled the German to enter and underbid the English manufacturer." These facts may be perfectly true, and may seem at first glance to have worked an injustice, but certainly such a condition of affairs cannot be attributable to this particular feature of the patent practice. We are inclined to believe that the value of a patent is governed principally by the ordinary laws of supply and demand, and we believe that in many cases it would work a great and real hardship to compel the inventor to introduce his invention at, perhaps, an enormous expense and sacrifice, or forfeit the rights for which he has paid. In many cases it is practically impossible for an inventor alone and unaided to introduce a patented invention. A vast amount of capital may be required; it may be necessary to establish an extensive organization in order to introduce the invention; those who wish to control the patent may have a monopoly of such inventions and are unwilling to buy, and it seems a little hard to deprive the poor inventor of his rights simply because he fails to put the invention into actual practice within a limited time. If the invention is one of value and he is unable to introduce it himself, the time will surely come when some one will make him an offer, which it may be possible for him to accept. The inventor will then have received the reward of his invention, and the public will receive the benefit derived from his labors.

We are pleased to learn that before the deputation left Mr. Balfour, it was gravely remarked that the latter's reply proved "most unsympathetic." It is to be hoped, therefore, that nothing more will be heard of the matter.

ADJUSTABLE CLAW-BAR.

The claw-bar here illustrated is designed more particularly for drawing rail-spikes, and, as the title indicates, it is so constructed as to permit rapid adjustment or removal of the claws when desired. The claws are straight steel bars of triangular cross-section which enter corresponding openings in the claw-head, and are held in place by set-screws. The handle of the tool fits into an opening in the top of the head and is held therein by a set-screw at the side. Lips are formed on the head outside of the claws and brace them to prevent spreading. The base edges of the claws are beveled at each end to permit slipping them under the spike to be drawn.

As soon as the claws are worn out or become dull along their inner projecting edges it is a simple matter to unloosen the set-screws and make an exchange of



ADJUSTABLE CLAW-BAR.

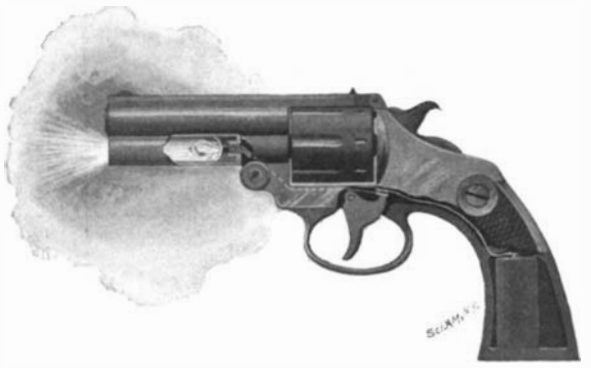
claws, i. e., to place the right claw in the left socket and the left one in the right socket, thus presenting new edges to the spike head. When the projecting ends are completely worn out the claws may be reversed in their seats, and when both ends are dulled they can be readily removed, the worn-out ends cut off, and then re-inserted in the head, or they may be replaced by new claws whenever desired.

By virtue of their shape the claws can be easily passed under the spike-head, and when pressure is brought to bear on the handle the rounded heel of the claw-head forms an excellent fulcrum on which the claws are raised and the spike withdrawn from the tie. Mr. Thomas Woodhouse, of Leadville, Colorado, is the inventor of this adjustable tool.

George W. Gardiner, of Philadelphia, has devised a propeller-gear which consists of a frame arranged in a trunk formed in the vessel, adapted to be lowered below the bottom so as properly to place the propeller in the water. If the vessel be of the centerboard type, the trunk carrying the centerboard may be enlarged so as to also receive the propeller-gear.

ODDITIES IN INVENTIONS.

COMBINATION REVOLVER AND DARK LANTERN.—The revolver shown in our illustration would be of inestimable value in case of an emergency at night. Its distinguishing feature lies in the small incandescent lamp situated in a reflector tube placed immediately below the revolver barrel. A battery in the



COMBINATION REVOLVER AND DARK LANTERN.

handle of the revolver may be electrically connected with the lamp by a slight pressure of the trigger. Thus, should a man suspect a burglar in the house, he can use his revolver as a dark lantern to find his man and insure good aim before firing. As soon as the piece is fired the trigger returns to its normal position and separates the electric wires, thus affording the operator the protection of darkness. Mr. F. D. James, of Seattle, Wash., has obtained the patent for this invention.

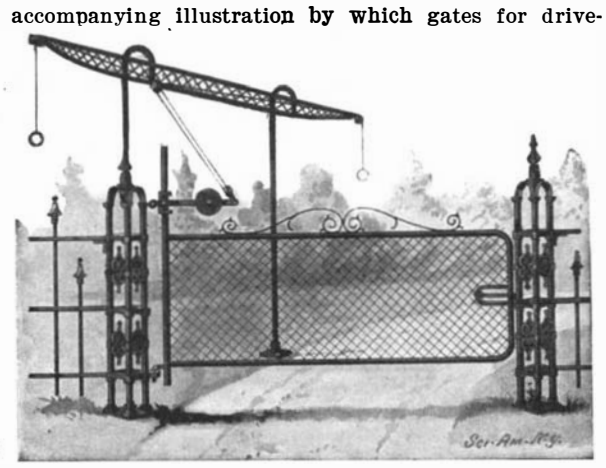
COW-MILKER.—There remain in these days of invention but few hand operations which cannot be

A COW-MILKING MACHINE.

far better performed by machine. Even the milking of cows is now done by a vacuum device. The apparatus comprises a can provided with an air-pump by which the air in the can may be exhausted to a certain degree of rarefication, as indicated by the vacuum-gage at the top of the can. A flexible tube is connected at one end with the can and at the other end with the udder of the cow by means of four teat cups. As soon as a sufficient portion of the air has been exhausted from the can the teats are placed in the cups and the stop cocks opened, which causes the teats to be drawn inward, making an air-tight joint. The suction then draws the milk through the hose into the can. A pneumatic ring in each cup prevents injury to the cow and an outer adjustable cylinder prevents the teat from being drawn in too far. The lower portion of each cup is glass, which permits the operator to watch the proper working of the device. The pump and gage are arranged to be easily applied to any milk-can. W. R. Thatcher and N. W. Hussey, of Oskaloosa, Iowa, are the inventors of this apparatus.

AUTOMATIC DRIVE-GATE.

A simple and inexpensive mechanism is shown in the accompanying illustration by which gates for drive-

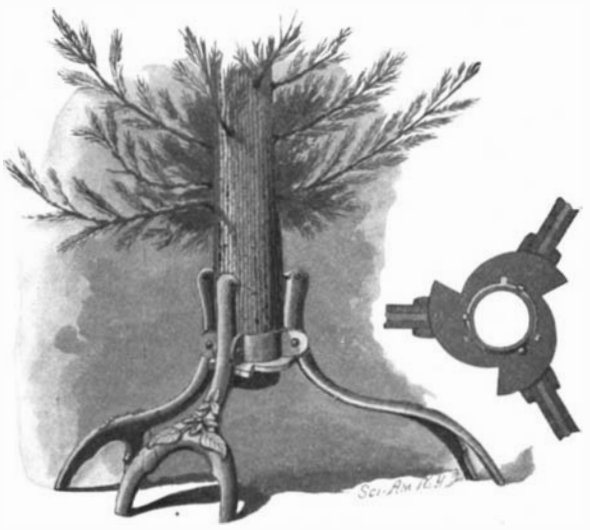


AUTOMATIC DRIVE-GATE.

ways may be opened or closed from either side by the driver while he remains seated in his vehicle. The gate is hinged to a post projecting upward a considerable distance above the fence. At the top of this post is a cross bar extending in both directions parallel to the roadway and supported near one end by a standard against which the gate swings when opened. Mounted to swing on the hinged post is a weight-actuated lever to which is pivoted a sleeve sliding freely on the pintle rod of the gate. The lower pintle of the gate fits loosely in an eye-bolt on the hinge post. It will readily be seen that by lifting up the weighted lever the upper pintle rod will be drawn back out of its horizontal position and be given a backward tilt. This, of course, will lift the gate off its latch, and since the center of gravity is changed the gate will swing around on its axis until it strikes the standard at the side of the road. The weighted lever is operated from the vehicle by a cord or draw-line passing through a pulley on the end of the lever and over pulleys on the cross bars. The depending ends of this draw-line are provided with handles, and are knotted just outside of the end pulleys, so as to prevent one end from sliding out of reach when the other is pulled down. To properly operate the gate, the draw-line should be given a smart pull, which will carry the weighted lever over past the vertical position and permit it to drop over toward the rear. As soon as the vehicle has passed, a quick pull on the other end of the draw-line carries the lever back past the vertical and permits it to swing to its original position. This restores the normal center of gravity and causes the gate to swing back against the fence post, to which it is secured by the ordinary gravity-latch. The gate was invented by Mr. P. C. Forrester, of Chicago, Ill., and is now being built, under the name of Forrester's Automatic Gate, at 269 Dearborn Street, Chicago, Ill.

TREE-STAND.

The stand illustrated herewith forms a simple yet very firm base for holding Christmas trees and the like. After the tree has been placed in position the device can be firmly locked, thus insuring perfect rigidity of the connection. The body of the device is tubular in form, tapering to a smaller diameter at the bottom, so that the tree may be firmly wedged therein. The legs, which are pivoted to this body portion, have a wide extension so as to present substantial bearing on the floor. On the upper inner portion of each leg a spur is formed. These spurs are adapted to sink into the trunk of the tree. When the tree is forced into the body of the device, the legs are first drawn together, thus spreading the spurs apart to admit the tree trunk. After the tree is seated, however, its weight spreads the legs apart and causes the spurs to sink into and grip the trunk. Mounted to rotate on the bottom of the



TREE-STAND.

body portion is a disk having three peripheral cam surfaces, one for each leg. As soon as the tree has been secured in the stand this disk may be turned to bring the cam surfaces into proper contact with the inner faces of the legs and thus lock them in their gripping position. The stand is the invention of W. C. Krick, of 1287 Broadway, Brooklyn, N. Y.

Acetylene-Black.

Lamp-black, which for hundreds and hundreds of years has been the chief ingredient in dark pigments, may perhaps be eventually displaced by acetylene-black. The chief merit of the new substance lies in its freedom from grease and, therefore, in its more ready manipulation. It is said that acetylene-black is admirably adapted for the uses of the manufacturer of printing inks. The high cost of acetylene-black is the only obstacle that bars its general introduction. A field is, therefore, opened to inventors in devising a method of producing the substance cheaply in large quantities. At present the black pigment is obtained by decomposing acetylene through the medium of an electric spark.

RECENTLY PATENTED INVENTIONS.

Apparatus for Special Purposes.

METALLURGICAL CRANE.—D. W. BLAIR, Perth Amboy, N. J. The crane is used for handling the anodes and cathodes of a metallurgical bath, more particularly of the kind used in copper works. Skeleton frames supporting depending hooks are rockably mounted on the main frame. The frames can be shifted endwise and a single series of hooks will answer for both the anodes and cathodes.

CARBURETER.—C. L. CHAMPION, St. Louis, Mo. The carbureter is arranged to furnish a supply of gas of uniform richness and in the exact quantities required for immediate consumption. The lower portion of the generator casing is filled with loose material, such as sponge, cotton, ground coke, etc., and on top of this material stands the hydrocarbon liquid at a predetermined level. A pump is connected with the carbureter and pumps air through the material. By regulating the quantity of air supplied, gas of different degrees of richness may be produced.

Hardware.

SNAP-HOOK.—G. W. H. SHREFFLER, Lockhaven, Pa. In this snap-hook the inventor avoids the usual button serving as a means for pushing the pin back against the spring. A shield is located outside of the casing in which the pin slides, connection between the shield and the pin being such that pressure applied to the former will be communicated to the latter. This arrangement not only overcomes the disadvantages of the button design, but also prevents water entering and freezing in the casing, thus clogging the pin.

PENCIL-SHARPENER.—E. BURKE, Lakeview, Ore. In this invention a novel attachment is provided for pocket knives which greatly facilitates their use in sharpening lead pencils and also enables the safe employment of the knife as an ink eraser, if desired.

TUBE-CLAMP.—W. DE FREITAS, New York, N. Y. By this invention Mr. Freitas supplies us with a clamp of simple and inexpensive construction that may be quickly applied to make a gas-tight joint between a rubber tube and a gas-cock or nipple and prevent accidental detachment of one from the other.

WASHER-FASTENER.—J. W. SHAW, Berryessa, Cal. This fastening device will firmly hold the washer in a hose-coupler or the like and not interfere with the passing of water through the same. A wire spring is seated along the inner periphery of the washer and terminates in points which project through the side walls of the washer and engage the thread on the coupling.

NUT-LOCK.—R. S. BOYKIN, Moselle, Miss. The nut-lock comprises a collar having a square opening which fits on the squared end of the portion of the bolt projecting beyond the nut. Fingers on the collar fit into holes in the nut and a spring latch holds the collar in place.

ROD-HANGER FOR WINDOW-SHADES.—C. H. BACON, Danielson, Conn. The rod hanger is arranged to form a permanent part of the shade and is easily placed and secured on the window frame to support and hold the shade in proper position. The hanger also serves as a binder or clamp to hold the shade cloth wound up on the roller when the window-shade is in stock at a dealer's store.

EYELET.—F. J. LELAND, Knoxville, Tenn. This invention relates to devices for lacing the ends of belts and provides an eyelet which is easily applied and arranged to preserve the belt from wear and damage. It comprises two members, each having an oblong hollow shank and a head, the latter having serrations along its edges which are adapted to sink into the belt. One of the shanks is provided with a plurality of shoulders on each side and the other with a tongue on each side adapted to spring into engagement with these shoulders.

Mechanical Devices.

FUR AND GLOVE SEWING MACHINES.—M. HASHFIELD, London, England. The invention has for its object to simplify the construction and increase the durability of the machine; to render the machine more noiseless in operation, and enable it to be run at a higher speed than other machines of the kind now in use. Mechanism is provided for imparting to the looper the various movements necessary for the formation of the stitch, namely, longitudinal reciprocating movement, vibrating movement in the longitudinal plane of the looper stem, and rocking movement about its longitudinal axis.

ORE-SEPARATOR.—J. M. MCCLAVE, F. H. KIRBY, and E. R. CUMBE, Denver, Colo. An electro-magnetic apparatus is employed for separating from sand or pulverized ores metals of weak magnetic action, and a dry process is used for the separation of ores of equal specific gravity, resulting in the saving of fine dust generally lost by the present methods.

CURVED-HAT-STAY-FLANGING MACHINE.—A. E. NIELSEN and F. BENTSEN, Brooklyn, N. Y. The hat-stay-flanging machine is more especially designed for flanging the undulating edges of tubular articles, such as paper supports or stays for nesting hats. The machine is very simple and durable in construction, and can be readily manipulated without the use of skilled labor.

CONVERTING MOTION.—C. H. FRALEY and G. F. MILLER, Alma, Neb. Messrs. Fraley and Miller have invented means whereby reciprocating motion can be converted into rotary motion. A reciprocating rod is connected with a lever and causes the latter to oscillate on its axis. Pawls on this lever engage a ratchet wheel which is thereby caused to rotate.

AUTOMATIC TROLLEY-CATCHER.—T. B. SHANAHAN, Gloversville, N. Y. The device is so constructed that the moment the trolley jumps the feed or line wire, it will automatically act to draw the pole downward and hold it in such position until sufficient slack is provided in the rope to permit the wheel of the pole to again connect with the feed wire. It is also so constructed that when the trolley pole rope is drawn therefrom the springs connecting with a drum in the device on which the rope is wound, will be turned in a winding direction.

Medical Apparatus.

HYPODERMIC SYRINGE.—JOHN N. FAIN and SIGNA L. HATFIELD, Wagoner, Ind. Ty. The syringe is so constructed as to be conveniently carried in the pocket; and is provided with chambers in which hypodermic needles and tablets used for forming different hypodermic injection mixtures are carried. It comprises a central cylinder in which a piston slides and two smaller cylinders or chambers oppositely disposed on the central cylinder. Means are provided for closing the central cylinder and locking the piston rod down in place.

Process Patents.

PROCESS OF MAKING DOLOMITIC SANDSTONE.—H. E. BROWN, Coldwater, Mich. The object of this invention is to produce compact, artificial stone. The sandstone is produced by the union of oxides of calcium and magnesium with various compounds of silica, forming a fine and compact structure, so that it can be used for all ordinary purposes of construction, as well as the finer decorative purposes and has great tensile and crushing strength, resisting also the disintegrating actions of the weather, as well as those of water.

PROCESS OF TREATING COPPER-NICKEL-SULFID ORES.—D. P. SHULER, Sudbury, Canada. The process relates to the treatment of ores containing, besides iron and nickel, non-magnetic elements, such as copper, in combination with sulphur. The main product of this process is pig iron containing a percentage of nickel, which makes it suitable for use in the manufacture of nickel-steel. Secondary products are an iron-nickel-copper matte and sulphur dioxide gas.

PROCESS OF PURIFYING ZINC-BEARING ORES.—C. R. P. STEINAU, Cleveland, Ohio. The process provides a commercially applicable method of purifying zinc-bearing solutions in such a manner as to remove any nickel or cobalt compounds that they may contain, so that lithopone made from such purified solutions will have a white color of a purity or perfection not hitherto attained.

Railway Contrivances.

NUT-LOCK.—M. MCDONALD, of Pictou, Can. The device is particularly adapted for use in fish-plates, bolts and nuts. It comprises a plate having openings which receive and conform to the shape of the nuts. This plate also has perforations near the ends which are engaged by locking-clips held to the fish-plates by the nuts.

OPERATING RAILWAY SWITCHES.—A. YOUNGBLOOD, North Augusta, S. C. The switch is designed to operate automatically while the engine is in motion. A projection on the rolling stock may be depressed to engage a switch frame in the center of the track, thereby throwing the switch. The inventor informs us that the switch has been given a practical test on the Georgia railroad, and operated perfectly at a speed of from 20 to 25 miles per hour.

CAR-COUPLING.—W. H. CORDILL, Brule P. O., Brule Co., So. Dakota. The object of the invention is to provide a device whereby a train of cars may be uncoupled at any desired point by turning the line of rods from either end of the train. The coupling-heads are placed inside a cylindrical draw-head provided with arms extending outwardly and forwardly, each draw-head being automatically locked to the cylinder of an opposing draw-head. When the rods connecting the couplings are turned, the coupling-heads are unlocked, thus disconnecting the car. By the turning of the rods the coupling-heads of a train are, one after another, brought under the control of the operator until the coupling is reached which is to be disconnected. Thereupon a single turn of the rod in the opposite direction unlocks this coupling and all the coupling-heads on the rod will be simultaneously returned to their initial positions.

Tools.

LINOLEUM-CUTTER.—F. L. TRIPP, Ellensburg, Washington. Linoleum may be accurately and smoothly cut by this cutter. The material is clamped securely between two blocks and the cutter slides along the upper block, having a guide at one side and a V-shaped knife along the other side which cuts the linoleum.

CHEESE-BOX TRIMMER.—H. W. QUADE, Watertown, Wis. This improved cheese-box trimmer is readily applied and manipulated, and easily adjustable for boxes of different diameters. It is arranged to quickly and accurately reduce the height of the side of the box to the level of the cheese therein or a little lower to allow for shrinkage of the cheese.

Vehicles and Their Accessories.

CORNER-IRON FOR VEHICLE-BODIES.—G. W. VINSON, Hazlewood, Ky. With this special corner-iron one bolt at each corner forms the sole means for fastening adjoining ends of the framing of the body, and is the only fastening connecting the framing with the corner-irons, save one or more screws passed horizontally through a downward extension of one side of the iron and the lower end of the extension bent horizontally to pass under the side boards of the body to support them and obviate strain on the devices connecting the sides with corner irons.

SINGLETREE-HOOK.—T. S. YOUNG, Fossil, Ore. The hook is constructed to include a safety keeper extending over the hook proper. It is made from a single length of metal bent between its ends to form the loop or ring to fit upon the end of the whiffletree and at its ends to provide the hook for engagement by the trace chain and the safety keeper overlying the hook.

BUCKLE FOR TUG-STRAPS.—W. H. ROSE, Bemidji, Minn. The buckle affords a reliable attachment for the end of a trace or tug strap upon hames of a harness and is convenient in adjustment to connect or release the strap. It avoids bending the trace at the point of connection, thereby reducing injurious wear to which such straps are ordinarily subjected.

Miscellaneous Inventions.

MATTRESS OR CUSHION AND HEATING ATTACHMENT THEREFOR.—A. G. SCHMIED, Marysville, Kans. The mattress or cushion is made of top and bottom portions which are connected at one side, one portion being provided interiorly with projections or ribs and spaces intervening them for accommodating a heater. The heater consists of a series of tubes made of aluminium, or of rubber when the cushion is to be bent. The tubes are filled with hot water.

BRUSH.—J. M. CHAMBERS, Thomaston, Conn. The brush is so constructed that when not in use the bristles may be folded onto the head or casing and covered up, the whole being in compact form, so that the brush may be conveniently carried in a person's pocket or packed with baggage. The invention is applicable more particularly to toilet brushes, such as hair, tooth and clothes brushes.

MEASURING INSTRUMENT.—I. B. HAGAN, North Lamoine, Me. The instrument is useful in describing and measuring angles and any of their branches. It comprises a graduated base rule, at one end of which is hinged a graduated angle rule, the angles being measured on a protractor plate. On the base rule is mounted a slide carrying a perpendicular rule also graduated. A spirit level is secured to one end of the base rule.

CUFF-HOLDER.—PAUL CUMMING, Key West, Fla. This invention provides a cuff-holder, easy to apply and remove, and one which may be manufactured at a low cost. The cuff lock in use is detachably secured to a shirt cuff and forms a novel detail of the invention. The swivel connection between cuff lock and the clasping arms permits an easy rotatable adjustment of the cuff on the wrist band of the shirt sleeve, as may be desired to properly dispose its lapped edges at the side of the hand of the wearer.

VACUUM-PAN.—G. L. RIBAUD, Grand Saline, Texas. The vacuum pan is provided with improved heating sections and an improved form of discharge chamber. The pan tapers at the bottom to an orifice, which is flanged for securing thereto a brass lined sleeve. Fitted within the sleeve and extending through the orifice is the neck of the discharge chamber. This neck is closed at the top, but is provided with apertures in its sides. When it is desired to remove the collected substance, the discharge chamber is filled with a supply of brine and then raised by any suitable means. The apertures in the neck are thereby brought into communication with the bottom chamber of the pan, effecting a transfer of the liquor to the pan and the collected salt to the discharge chamber.

BRUSH.—F. H. TUCKER, Invercargill, New Zealand. The brush consists of a compressible vessel of a suitable size and shape for holding water for the purpose of wetting the surfaces of paper. When filled with water and tightly corked, it is only necessary to slightly squeeze the compressible vessel, forcing the water to ooze out onto or through a felt brush which is applied to the paper.

BELT-GUIDE.—C. MCKEEN, W. BAYES, and W. HEYER, Winside, Neb. The guide not only prevents the belts from being misplaced by sudden gusts of wind, either vertical or horizontal, but also from undue wear of the edges, preventing turning and stretching.

FOLDING CRATE.—A. J. NOLTY, Memphis, Tenn. The folding crate has novel features of construction that adapt it for quick erection into a commodious receptacle for poultry, live game, fruits, and other products usually transferred to market in such inclosures. The improved crate is furthermore adapted for speedy collapse and close-folded adjustment of the parts that are all connected together.

PROPORTIONATE SCALE.—G. R. BROWN, Pledger, Texas. The scale is particularly designed for determining the relative proportions or percentage of lint contained in seed cotton. A disk is mounted to rotate on one of the fulcrum points of the beam. Blocks mounted to slide on the beam at opposite sides of the fulcrum are connected by links to the disk. A pan is supported on one of the blocks which slides along a graduated portion of the beam. A loop adjusted and fixed to the beam supports a second pan.

NON-REFILLABLE BOTTLE.—J. W. MCCRACKEN, Logtown, Miss. Novel details of construction are provided which may be easily placed in the neck of the bottle and are adapted to afford a closure therefor that permits the liquid contents to be freely decanted, but prevents the bottle from being filled in the usual manner.

CHAIR.—A. M. SMITZ, Depere, Wis. The chair is provided with a convenient adjustable and detachable device for supporting a book or the like in front of a person sitting in the chair and provides further a cover for a receptacle on the chair that may be used as a writing desk. This makes the chair very useful for students or invalids.

VENTILATOR.—I. C. RAMIREZ, Puebla, Mexico. The ventilator involves a vertically extending tube or conduit with absorbent material therein, in which tube is induced a current of air passing from the atmosphere into the apartment. This current is not only fresh, but is also cooled by the evaporation that takes place in the tube.

FRUIT-DRIER TRAY.—J. H. COLLINS, Nashville, Tenn. The drier frames are so constructed that in case of rain during the day they can be easily and quickly racked up and placed under shelter. When taken into the house at night they require but very little space, and as there will be from three to four inches space between the frames when racked up the fruit will continue to dry in the house.

NEEDLE-HOLDER.—R. MILLER, Cortland, N. Y. The invention relates to a means for conveniently carrying sewing materials in a toilet article, such as a comb, a hair ornament, or a hat pin, so that the toilet article will serve as a casing therefor, and be adapted for use in the usual way, but permit a ready removal of the sewing implements and material as occasion may require.

FISHING-GEAR.—A. W. WILSON, San Francisco, Cal. By practical observation, Mr. Wilson has noticed that minnows and other small fish when being chased by larger fish, swim erratically and "skitter" or swerve from side to side. This is probably due to excitement or exhaustion, and a trolling-spoon or artificial bait should be made to imitate these movements. Such fishing-gear is provided in this invention.

SPOOL-HOLDER.—J. H. HILTON, New York, N. Y. This portable spool-holder supports a number of spools in a simple and compact manner and may be hung upon a wall or placed on a table, sewing-machine or the like, without danger of any of the spools dropping out. It is also arranged to permit convenient access to the thread on any of the spools, and in case a spool is empty it can be readily removed and replaced by a full one.

FAUCET.—J. C. POETZ, Spokane, Wash. The faucet may be readily opened to permit the flow of water, and will close automatically by the supply-pressure. The main valve, which is directly exposed to the supply-pressure, has a piston normally free from this pressure and of greater area than the valve. Means are provided for admitting the supply-pressure to act upon this piston in opposition to the action of the supply-pressure directly upon the main valve, thus opening the valve. Pressure upon the main valve will close it when the supply-pressure of the piston is cut off.

SUSPENDERS.—I. WECHSLER, Brooklyn, N. Y. The device is so constructed as to be readily changed for use as ordinary suspenders, or as a waist belt. Metal clips at the front ends of the straps are so formed that they may engage one another to form a belt buckle or engage independently with the suspender ends.

HORSE-TAIL HOLDER.—H. E. GAVITT, Topeka, Kans. Mr. Gavitt has invented a horse-tail holder which can be easily applied and will efficiently serve its primary purpose of holding the tail in such manner as to present the appearance of being docked, and will also hold the tail done-up, as is desired when the horse is being used in mud. When in position the device is concealed from view. It consists essentially of a main strap secured by a loop to the crupper. On the main strap are a number of transverse straps employed in securing that portion of the tail which has been folded back just below the tail bone.

AMUSEMENT APPARATUS. — H. F. SCHRADER, Brooklyn, N. Y. This invention relates to an amusement device simulating an old Dutch windmill and its surroundings, these including a canal, or mill-race, through which boats are drawn by any desired power.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 2484.—For a floor mop that does not require wringing by the hands.

Factory room to let, with power, steam, elevators, etc. Good light, also storage room. Charles F. Kilburn, 84-86-88 Mechanic St., Newark, N. J.

Inquiry No. 2485.—For an apparatus for placing in a vertical furnace so as to use oil as fuel.

Designers and builders of automatic and special machines of all kinds. Inventions perfected. The W. A. Wilson Machine Company, Rochester, N. Y.

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Inquiry No. 2489.—For the manufacturers of the Acme oil and gas engine.

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Inquiry No. 2510.—For dealers of aluminium in sheets.

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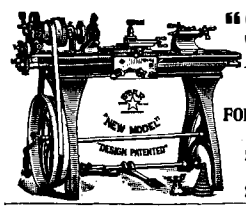
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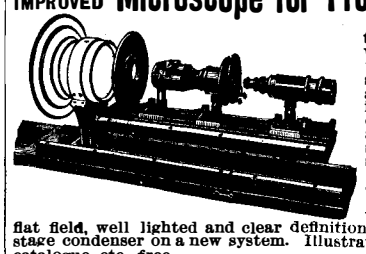
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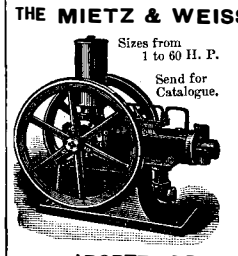
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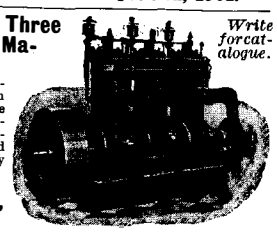
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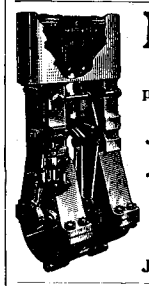
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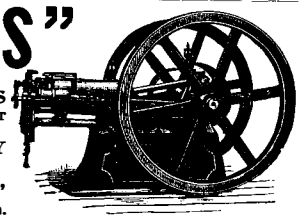
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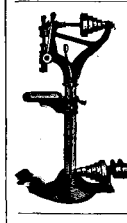
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Mr. Ashley has produced a book of the kind that one loves to handle and to read. It is scholarly in its treatment, yet simple in its explanations. It is a textbook intended not only to describe the organization and work of the different American governments, but to emphasize the relation of citizens to the government and to one another. For that reason, Mr. Ashley informs us in his preface, he has approached the subject from the standpoint of the State; that is, of the whole body of citizens considered as an organized unit, rather than from the point of view of government or of the individual citizen. How well he has succeeded even a cursory examination of his book will show.

HANDBOOK ON ENGINEERING. By Henry C. Tulley. Second Edition, Revised and Enlarged. St. Louis: Henry C. Tulley & Co. 1902. 16mo. Pp. 827. Price $3.50.

This is the second edition of a book which has been found of considerable service to the practical engineer. The author's claim that before the publication of the volume, it was difficult to find a plain and practical treatise on the steam-boiler, steam-pump, steam-engine, and dynamo, and how to care for them, is only too well founded. His own work seems to fill this want in a particularly happy manner. He has given particular attention to the latest improvements in all classes of steam engineering and their proportioning according to the best modern practice.

BAKING POWDERS. A Treatise on the Character, Methods for the Determination of the Values, etc. With Special Reference to Recent Improvements in Phosphate Powders. By Charles A. Catlin, B.S., Ph.B., F.A.A.S. Providence, R. I.: Rumford Chemical Works. 1899. Pp. 44.

Mr. Catlin has prepared an interesting monograph on baking powders which will commend itself both to the chemist and to the baker for the thoroughness of its treatment and the trustworthiness of its information.

PRACTICAL SANITARY ENGINEERING. By Francis Wood. Philadelphia: J. B. Lippincott Company. London: Charles Griffin & Co. 1902. 16mo. Pp. i to vii, 304.

Mr. Wood's work deals with the science of sanitary engineering in an elementary form. As the author states in his introductory chapter, the material formed the basis of a series of lectures given before a few private engineering friends, and is now offered more especially to engineering students. It cannot be denied that the work is both instructive and trustworthy. Its illustrations might, however, be improved here and there.

ELECTRICAL ENGINEERING TESTING. A Practical Work for Second and Third Year Students, Engineers and Others. By G. D. Aspinall Parr, M.Inst. E.E., A.M.I. Mech.E. 218 Diagrams of Connections and Illustrations of Appliances. 31 Tables of Useful Figures, Constants, Logarithms, Squares, etc. Philadelphia: J. B. Lippincott Company. London: Chapman & Hall, Ltd. 1902. 8vo. Pp. 474. Price $3.50 net.

Electrical periodicals from time to time have published articles on the testing of electrical engineering apparatus. So far as we know, the present book is the first earnest effort to treat the more advanced and practical portions of the subject in a systematic manner and to collect scattered information not readily accessible. The book embodies most of the experimental work that is usually done at colleges, and includes many tests of heavy electrical machinery, together with a course on jointing electric light cables. The author's hope that his book may be suitable to guide the student in electrical laboratory practice in the second and third years of a complete course of instruction in electrical engineering deserves to be fulfilled.

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With the publication of the fourth instalment, the Cyclopedia of Horticulture is now complete. In the retrospect which forms the preface of this last volume, the author has shown convincingly how laborious has been his task and how carefully he has endeavored to perform it. So far as we are aware, the book

(*Continued on page 319*)

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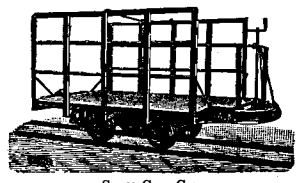
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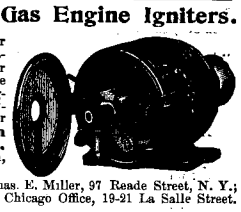
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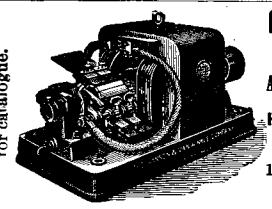
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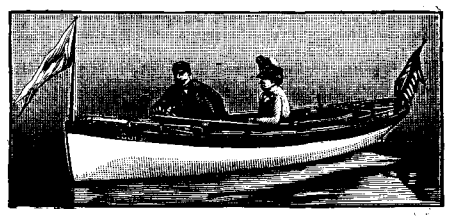
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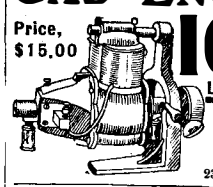
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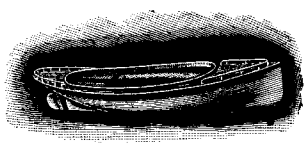
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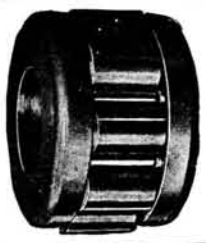

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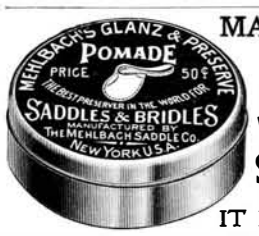

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AMERICAN NEWSPAPER ANNUAL, 1902. Philadelphia: N. W. Ayer & Son. 1902. Crown 8vo. Pp. 1601.

Perhaps the most exhaustive and the most trustworthy business directory of newspapers published in the United States is that issued by the well-known advertising agents, N. W. Ayer & Son, of Philadelphia. The volume before us follows the general plan which has been adopted in past annuals—a plan which experience has shown to be in every way the most adequate. The 1902 annual contains a carefully prepared list of the newspapers and periodicals published in the United States, Territories, Dominion of Canada, Cuba and the West Indian Islands, and gives valuable information regarding these periodicals, such as circulation, issue, date of establishment, names of editors and publishers, and addresses, together with the population of the counties and places in which the papers are published. Furthermore, the book contains a description of every place in the United States and Canada in which a newspaper is published, including railroads, telegraph stations and banking facilities as well as maps of the United States and its possessions, Canadian provinces and the West Indian Islands. A list of the newspapers of the United States and Canada is arranged in counties and a description is given of each State, Territory, province and county, as well as the location, use, character of surface and soil. Chief products and manufactures are also mentioned. The work, containing as it does information of the most varied and useful character, constitutes a valuable guide for the judicious placing of advertisements.

FUNDAMENTAL PRINCIPLES OF ASCERTAINING COST OF MANUFACTURING APPLIED TO MANUFACTURING PRINTING. APPLICABLE TO ALL OTHER KINDS OF MANUFACTURING. By J. Cliff Dando. Philadelphia: Dando Printing and Publishing Company. 1901. Quarto. Pp. 88. Price $10.

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POWER TRANSMISSION. By E. W. Kerr, M. E. New York: John Wiley & Sons. 1902. 8vo. Pp. 356. Price $2.

The author has taken an old subject, which has been worn threadbare, and has acquitted himself in an excellent manner. The contents are largely the subject matter of lectures delivered by the author to students of the elementary principles of engineering. The examples for practice are excellent. The book is well illustrated.

THE TRAINING OF THE BODY FOR GAMES, ATHLETICS, GYMNASTICS, ETC. By F. A. Schmidt, M. D., and Eustace H. Miles, M. A. New York: E. P. Dutton & Co. 1901. 8vo. Pp. 520. Price $2.50 net.

The volume contains hints that will be valuable for all those who are interested in sports and out-of-door games. The authors' special object is to point out the peculiarities of the different forms of exercises and their relation to a perfect, all round development. The authors take up the subject matter from new points of view, and the explanations are so lucid that they can be readily comprehended by the lay mind. The illustrations are particularly unique.

MARINE PAINTING IN WATER COLOR WITH TWENTY-FOUR EXAMPLES IN COLOR. By W. L. Wyllie, A. R. A. London and New York: Cassell & Co.

The examples are admirable and the explanations are most simple. The book is one that can be especially commended to all amateur artists.

THE MASTERY OF THE PACIFIC. By Archibald R. Colquhoun. New York: The Macmillan Company. 1902. 8vo. Pp. 440. Price $4.

The writer is well known as a traveler in foreign lands, and a student of foreign affairs, but more especially of the questions which find their focus in the Far East. Among the changings and shiftings of human activity which have taken place in the world's history, none have been more striking than those which are rapidly transforming the great ocean zone of the Pacific. The book is admirably written and is profusely illustrated by unique photographs, and it is especially recommended to persons who wish to post themselves upon one of the vital questions of the day.

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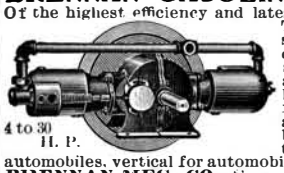

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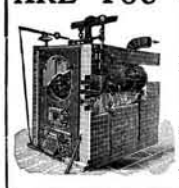

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References to former articles or answers should give date of paper and page or number of question.

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(8592) H. E. S. writes: In the SCIENTIFIC AMERICAN, in Query 8558, H. E. G. wants to know if the three-wire system of distribution is ever used in connection with a single-phase current. If, as I take it, he refers to the secondary mains, or mains from which the service wires leading into buildings are taken, such a system is in use in quite a number of lighting plants. Here our primary voltage is 2,100 volts. Most of our transformers are connected up on the three-wire system, with a voltage of 208 between the two outside wires, or 104 between either outside wire and the center or neutral wire. Most of our customers are supplied with current at 104 volts. Customers having less than ten lights are wired on the two-wire system, larger consumers are wound on the three-wire system, and service wires connected with the mains in accordance. We have one transformer, from which a two-wire 208-volt circuit runs in one direction and a three-wire 208—104-volt circuit runs in another direction. A. It may be that we did not interpret the inquiry of our correspondent H. E. G., No. 8,558, correctly, but we understood him to refer to the mains from the generator to the transformers when he asked if a single-phase current can be operated on a three-wire system. Of course, we were aware that such a current could be connected to the Edison system of house wiring from the secondary of two transformers or from one transformer by tapping the secondary at three equidistant points.

(8593) F. H. P. asks: Is it possible to wind a spark coil of the simple pattern and make a jump spark coil of it? If so, kindly give directions and state the way it should be coupled up. A. A simple spark coil may be made with a core of iron wire (No. 16) 10 inches long and one inch in diameter. Fasten heads for the spool on this, and cover the core with a few turns of brown paper. Wind No. 14 single cotton-covered magnet wire on this to a depth of about 5/8 inch, insulating each layer from the next by a layer of paper. It is better to give each layer a coat of shellac also. The coil is used in series with a battery, and the spark is obtained when the circuit is broken. With six or eight strong cells a thick spark will be given.

(8594) F. H. R. writes: I have a stereopticon lantern, and have been experimenting some with it. For a screen I have a blank wall tinted an orange red. Can you tell me what colored glass I can use with my lens in order to throw a white light upon the red surface? A. To obtain the best effect you must find a glass of a tint the exact complementary of the color of the wall. This will be a bluish green. Of course much light is lost both by the absorption of the wall and of the glass. We should suppose that very little would be left.

(8595) C. F. C. By oversight answer to your inquiry regarding carbon velox was omitted from our answer to your other inquiries. The directions accompanying carbon velox paper are that in ordinary daylight an average negative will require from one to eight seconds; an arc lamp is given as requiring about the same time; a Welsbach burner as requiring several more seconds; and a five-foot gas burner at three or four inches as requiring from one to two minutes of exposure. Velox paper is opened and handled by gas light; from which it is seen that it is less sensitive than ordinary lantern slide plates, though there are brands of these which are manipulated in yellow light.

(8596) F. I. G. asks: I have read the statement in a medical journal that Prof. Fittika, of Marburg, claims that arsenic is PN_2C and that antimony is $P_2N_2O_2$. Can you tell me if he or any one has demonstrated the above? A. In the latest published list of elements, under the authority of the American Chemical Society, the names of arsenic and antimony are both given. We do not think chemists have concluded that any one has proved that the substances named have been decomposed into any simpler forms. It is of course possible that the so-called elements are not all or any of them elements, and investigators at some time may be rewarded by the discovery of the method of separating the ele-

(Continued on page 331)

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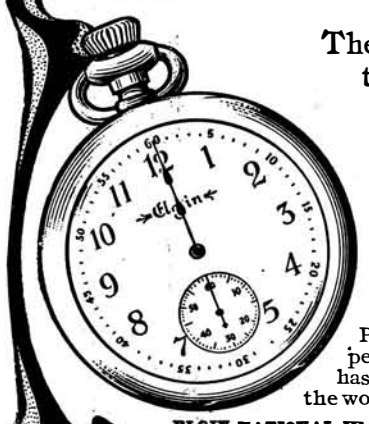

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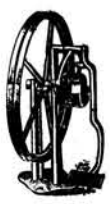

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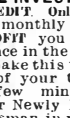
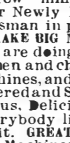
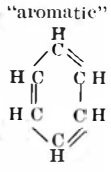
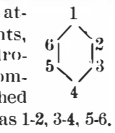
ments into simpler forms. It has not, however, yet been done to the acceptance of competent chemists.

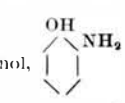
(8597) G. M. C. asks: 1. What is the difference between the current generated by a magneto machine and that generated by a dry battery? I notice that the former cannot be used like the latter for lighting a miniature lamp and for some other purposes. A. The magneto of a telephone set generates an alternating current of too small amperage to light a lamp. 2. Will a standard Fuller battery become exhausted by standing with its poles disconnected? If so, why? A. All bichromate cells should have the zincs lifted out of the liquid when not in use, because the acid acts upon and dissolves the zinc all the time it is in contact with it. 3. When the poles of a battery are connected through a circuit of practically no resistance, so that the battery does no work, what becomes of its energy? A. You are in error in saying that the battery does no work when on short circuit. It is sending a maximum of current and produces a maximum of heat. 4. Can an incandescent lamp be destroyed by sending too strong a current through it? A. Certainly. 5. What are gas mantles composed of? A. Gas mantles are composed of oxides of the rare earths upon a mesh of thread, which burns when the mantle is lighted by a match, leaving the oxide to glow with the heat of the flame.

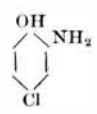
(8598) H. M. W. asks: Will you kindly inform me what the following consist of, viz.: Ortho-amido-phenol, 4 chlor-ortho amido-phenol, 4 6 dichlor-ortho-amido-phenol, 4 nitro-ortho-amido-phenol, 4-6 dinitro-ortho-amido-phenol, 4 chlor-6 nitro-ortho-amido-phenol? A. The composition of the organic compounds is difficult of representation except by the method of the chemistries, or by means of a diagram. Benzole, or benzene, is the basis of the "aromatic" or "ring" compounds. Its formula is C_6H_6; or expressed graphically, it is a lozenge-shaped figure, as shown here, with six points for bonds. Since this is a very troublesome formula to write out continually, it has come to be conventionally symbolized by a hexagon, the six angles of which are numbered from the top around with the hands of a clock from 1 to 6. When nothing is attached to any of the numbered points, it is understood that one atom of hydrogen occupies the position. "Ortho-compounds" are those in which the attached radicals occupy adjacent points, such as 1-2, 3-4, 5-6. "Meta-compounds" are those in which the attached radicals occupy alternate points, as 1-3, 2-4, 3-5. "Para-compounds" are those in which the radicals occupy opposite points, such as 1-4, 2-5, 3-6. "Phenol," or carbolic acid, C_6H_5-OH, is denoted by the diagram  "Amido-compounds" are those containing the radical NH_2. Hence amido-phenol is represented by the diagram 

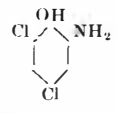


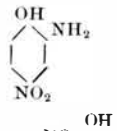


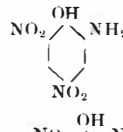
Hence also there may be three amido-phenols—ortho-amido-phenol, meta-amido-phenol, and para-amido-phenol. The compounds named above are all of the "ortho" series. The numbers used in the names refer to the number of the points of the lozenge as above stated. It is now possible to indicate the composition of the compounds intelligibly—

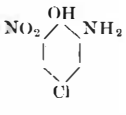
Ortho-amido-phenol, 

4 chlor-ortho-amido-phenol, 

4-6 dichlor-ortho-amido-phenol, 

4 nitro-ortho-amido phenol, 

4-6 dinitro-ortho-amido-phenol, 

4 chlor-6 nitro-ortho-amido-phenol, 

The formulas in the ordinary mode of writing are as follows:

Ortho-amido-phenol,
$C_6H_4\ NH_2$-OH.

4 chlor-ortho-amido-phenol,
C_6H_3-Cl-NH_2-OH.

4-6 dichlor-ortho-amido-phenol,
C_6H_2=Cl_2-NH_2-OH.

4 nitro-ortho-amido-phenol,
$C_6H_3\ NO_2\ NH_2$-OH.

4-6 dinitro-ortho-amido-phenol,
C_6H_2=$(NO_2)_2$-NH_2-OH.

4 chlor-6 nitro-ortho-amido-phenol,
C_6H_2-Cl-NO_2-NH_2-OH.

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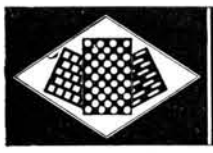

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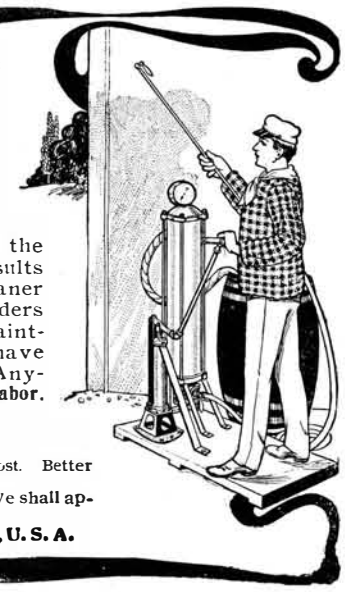

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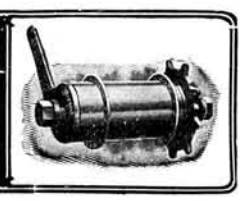

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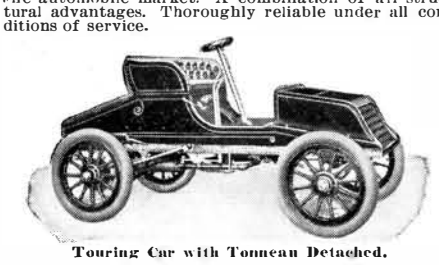

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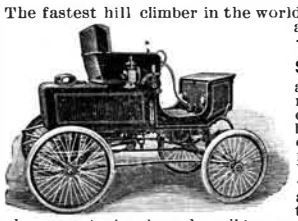

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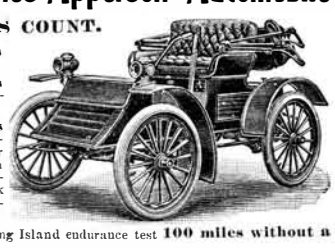

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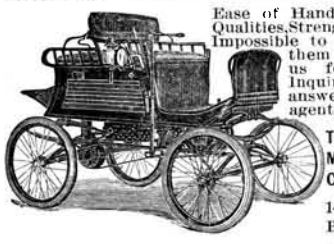

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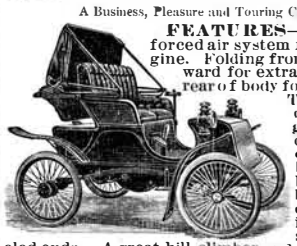

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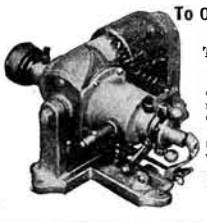

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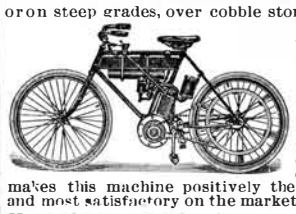

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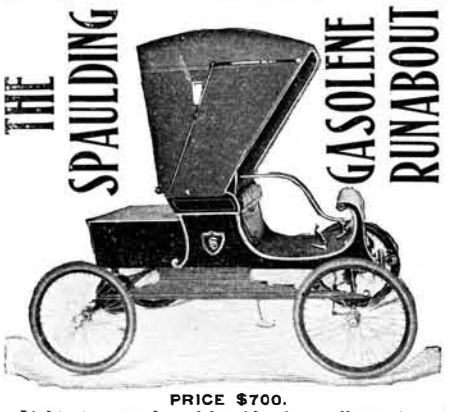

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